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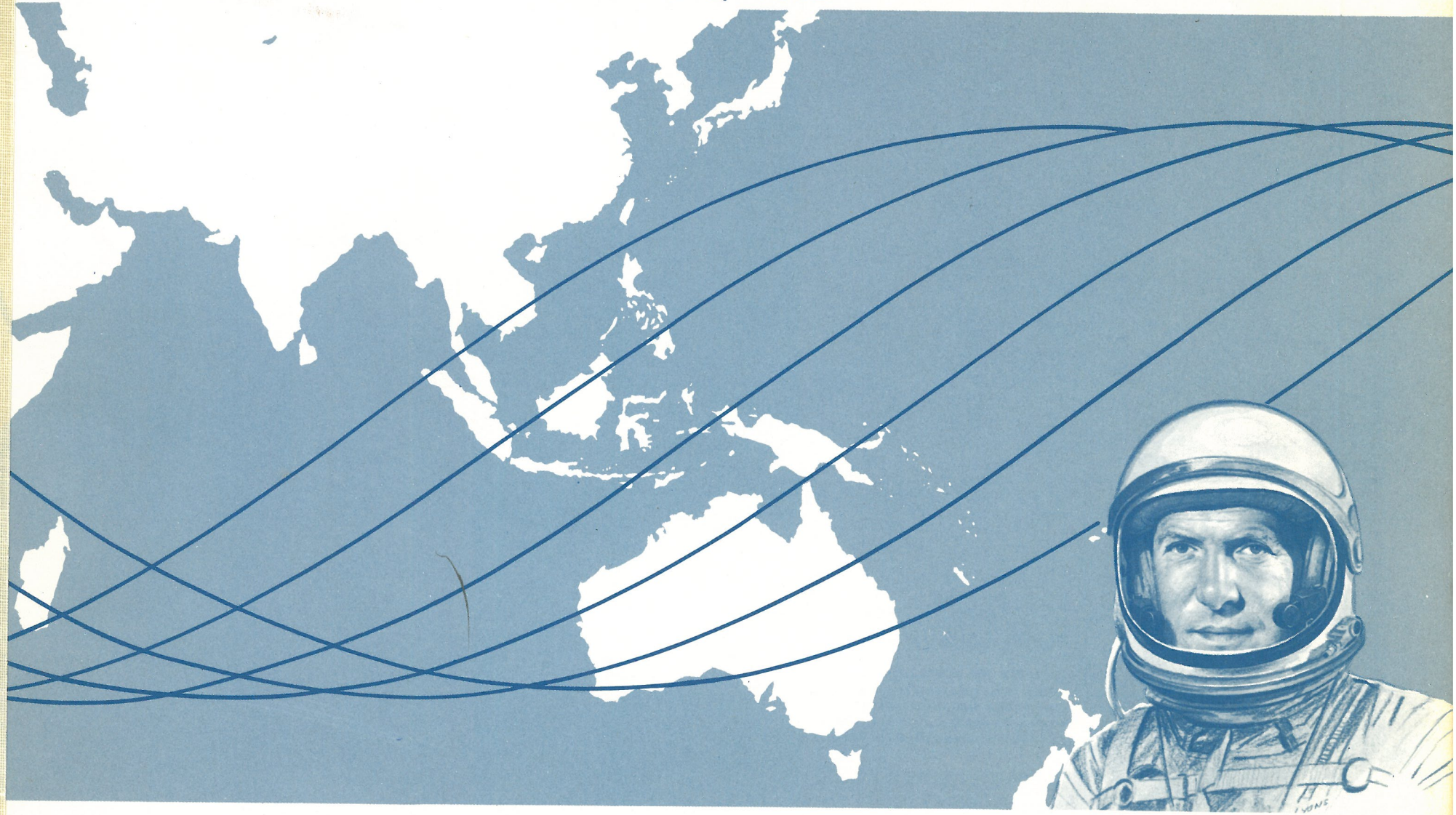
THE SIX ORBITS OF SIGMA 7

WALTER M. SCHIRRA'S SPACE FLIGHT

OCTOBER 3, 1962



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MANNED SPACECRAFT CENTER

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THE SIX ORBITS OF SIGMA 7

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ASTRONAUT WALTER M. SCHIRRA, JR., Mercury-atlas 8 pilot, left, received the National Aeronautics and Space Administration's Distinguished Service Medal from NASA Administrator James Webb at Oradell, New Jersey, October 15.

At 7:15 AM, October 3, 1962, Project Mercury Astronaut Walter M. Schirra, Jr., in his Sigma 7 spacecraft was launched into space, boosted by an Atlas launch vehicle which developed 360,000 pounds of thrust. Six orbits and nine hours and 13 minutes later he splashed down in the Pacific about 295 miles northeast of Midway Island—less than five miles from the target set prior to the 160,000 mile journey in space.

This accomplishment attests to the high state of the art acquired by Project Mercury personnel as it has gone through a planned step-by-step progression under the direction of Dr. Robert R. Gilruth, Director of Manned Spacecraft Center, and Walter C. Williams, Associate Director.

The flight itself, termed by Schirra after his return to the United States as "a text-book flight," followed a plan which was actually a compilation of input of engineering, operations and medical personnel, integrated into a single plan, and accepted and carried out by Schirra.

Principal benefits from the six-orbit mission were the development of operational techniques and procedures which are directly applicable to manned one-day missions. Schirra maintained a close check on the environmental control system, and, according to him, the pilot control of the systems in an effort to control use of fuel has been proven and suit temperature no longer presents a problem.

Another benefit is the experience with the attitude control with changes incorporated in the MA-8 flight. Both the low thrusters (one-pound) and high thrusters (24-pound) performed perfectly when called upon by the pilot.

Schirra went through a period of more than nine hours of weightlessness without nausea or other ill-effects. His flight has provided invaluable information concerning the extended phases of drifting flight which will be used extensively in the one-day mission.

The Sigma 7 spacecraft attained a speed of approximately 17,560 miles per hour, a perigee (low point of orbit) of 100 statute miles, and an apogee (high point of orbit) of 176 statute miles.

Project Mercury, as a result of information gathered from Schirra's flight, the preceding three-orbit flights of Astronauts John H. Glenn, Jr., and M. Scott Carpenter, and the sub-orbital flights of Alan B. Shepard, Jr., and Virgil I. Grissom, is now ready to move onward to its last planned phase of the investigation of space—manned one-day missions.

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The Project Mercury Astronauts have worked closely as a team since their selection for the program in April 1959. They have all participated in some capacity in each of the manned space flights. During the MA-8 mission they were assigned as follows:

Astronaut Walter M. Schirra, Jr. – pilot

Astronaut L. Gordon Cooper, Jr. – back-up pilot

Astronaut Donald K. Slayton – capsule communicator, Mercury Control Center

Astronaut M. Scott Carpenter – capsule communicator, Guaymas, Mexico

Astronaut John H. Glenn, Jr. – capsule communicator, Pt. Arguello, Calif.

Astronaut Virgil I. Grissom – capsule communicator, Kauai Island, Hawaii

Astronaut Alan B. Shepard, Jr. – capsule communicator, Pacific Command Ship

SCHIRRA

COOPER

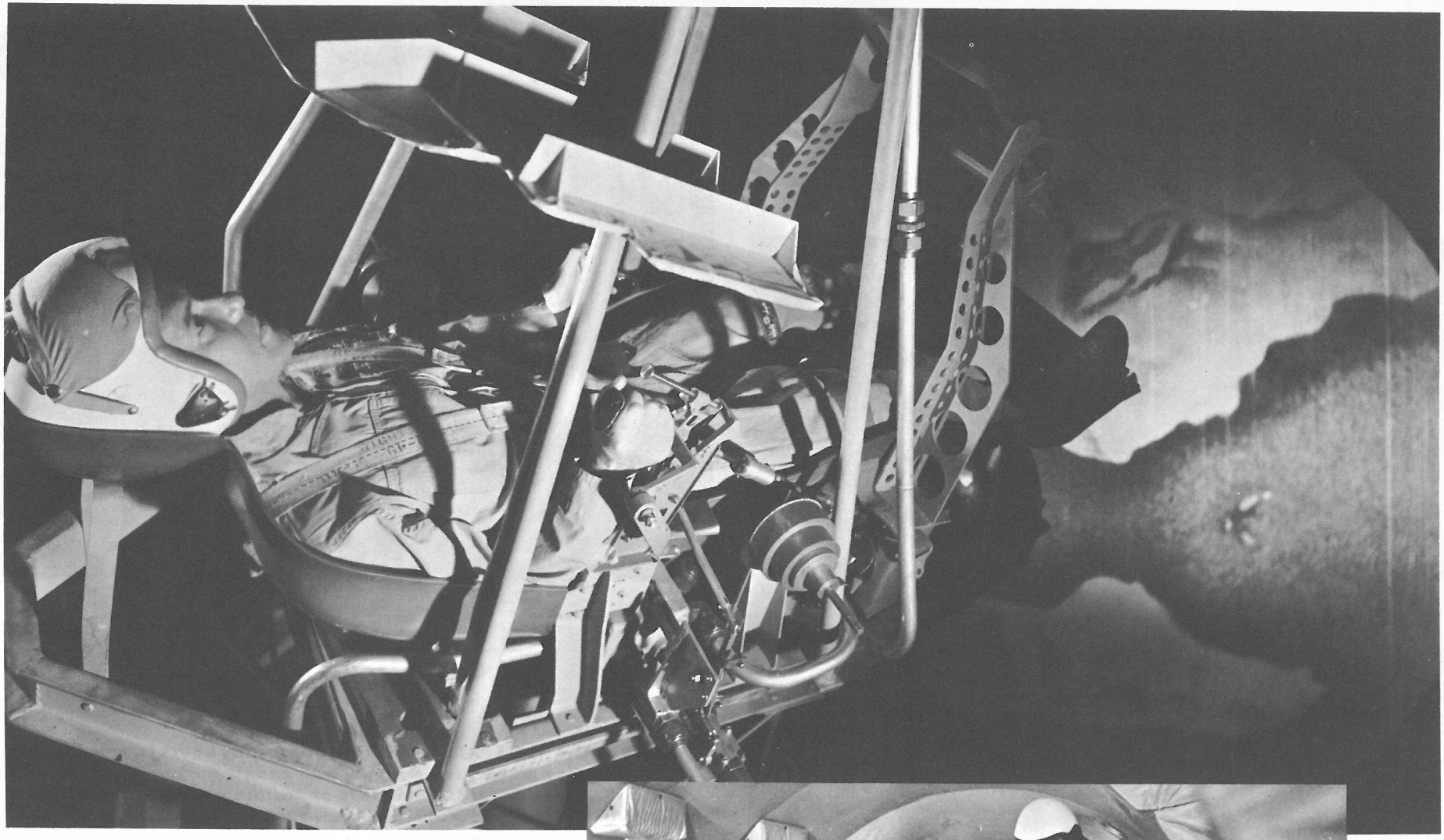
SLAYTON

CARPENTER

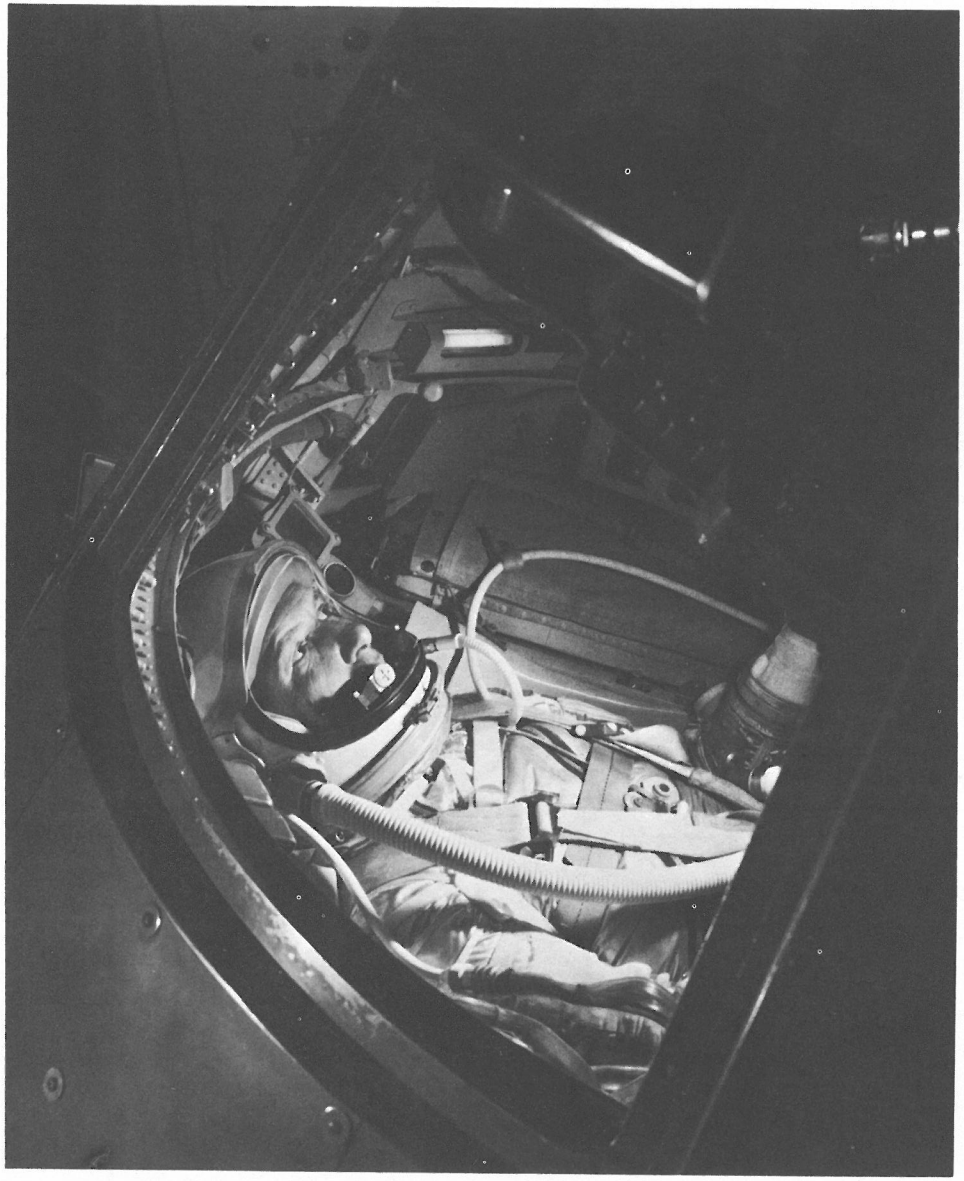
GLENN

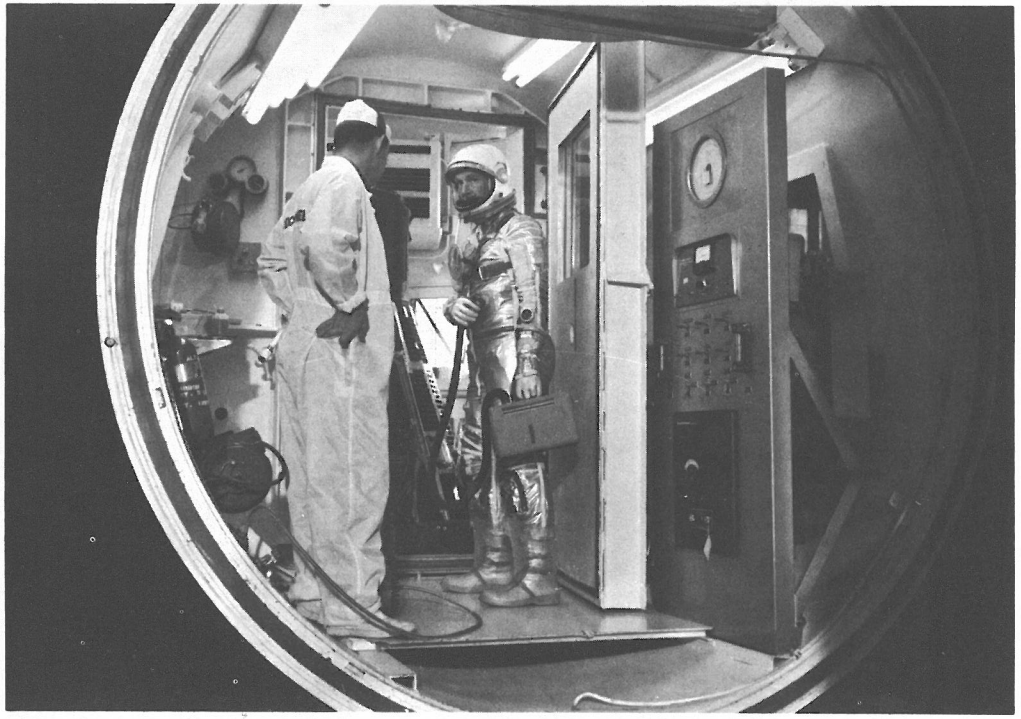
GRISSOM

SHEPARD



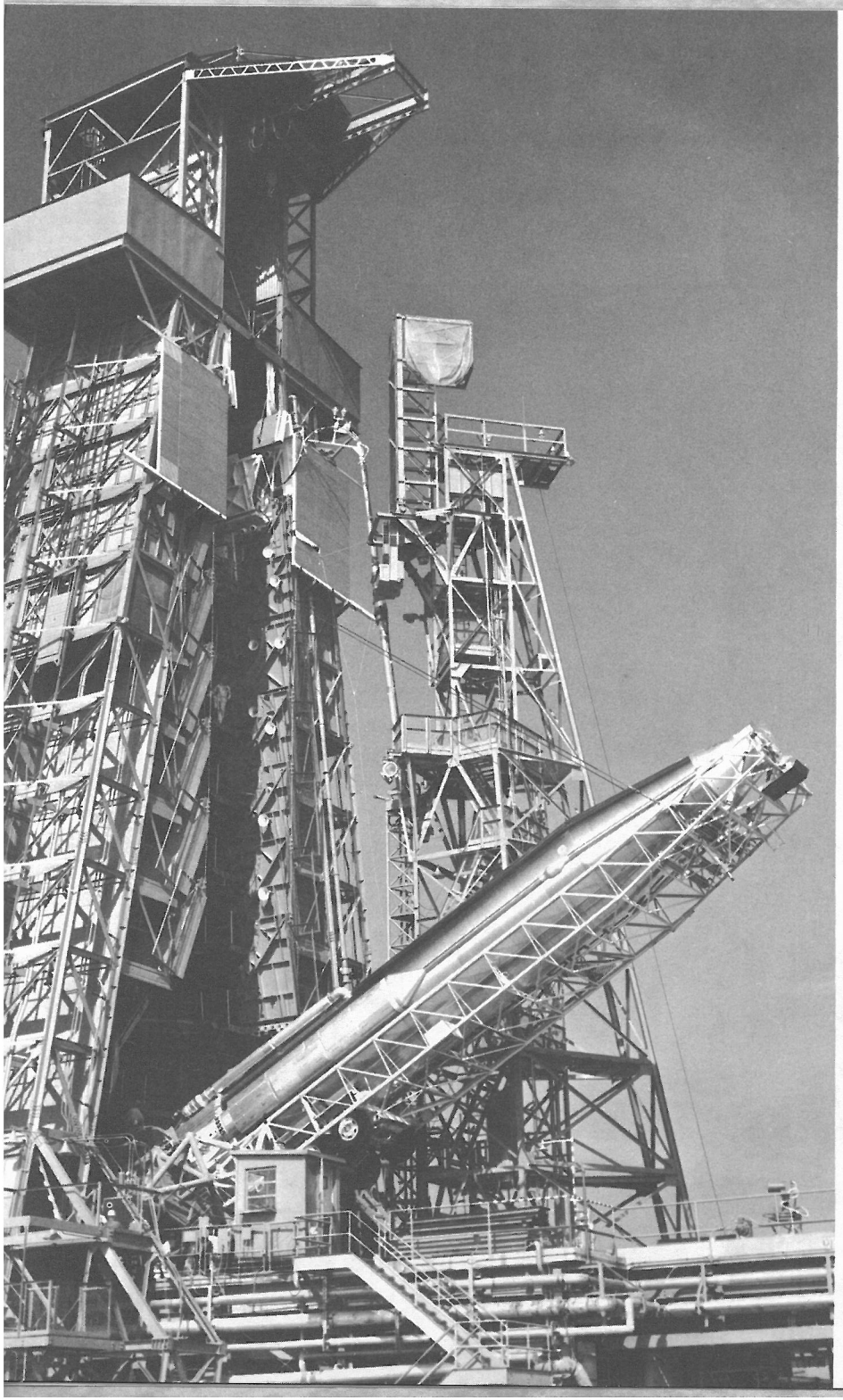
THE ALPHA TRAINER is a device which allows an astronaut to see the image of the earth's surface at his feet while manually controlling the device through pitch, roll and yaw maneuvers. Schirra is pictured above in the trainer during an early phase of his training. At the right Astronauts Virgil I. "Gus" Grissom and L. Gordon Cooper, Jr., back-up pilot for the MA-8 mission, are shown as they underwent weightlessness experiments which acquainted them with the sensations of zero gravity.



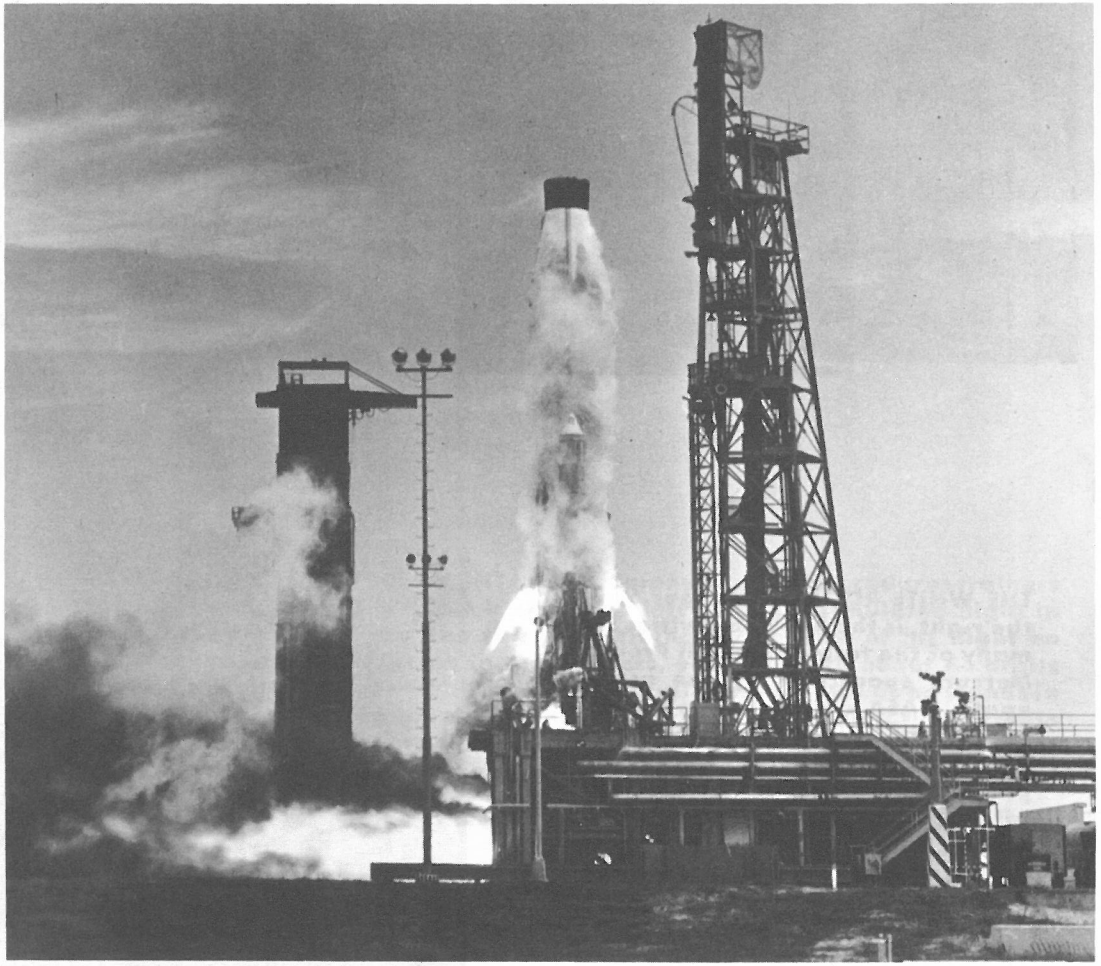


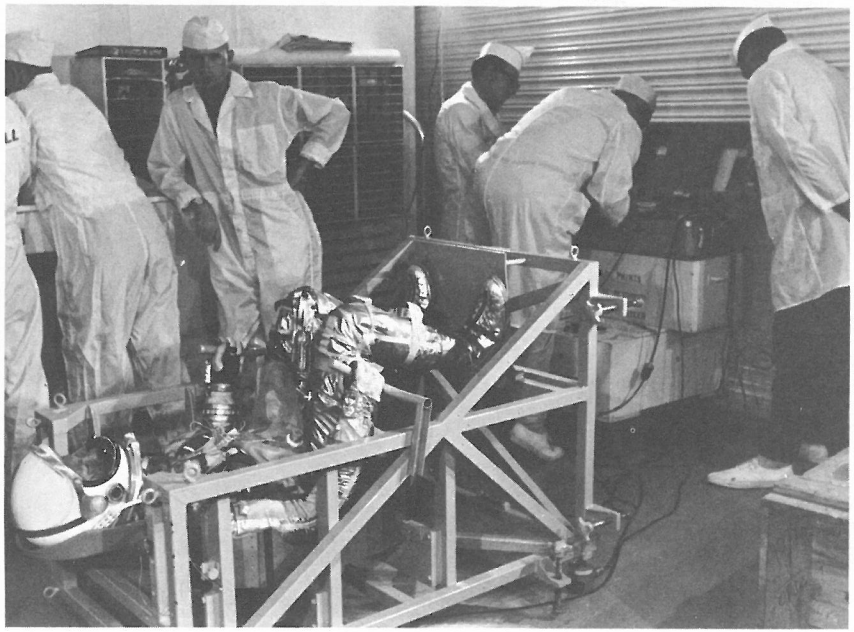
PREPARATION FOR SPACE FLIGHT includes many hours in procedures trainers for all the astronauts. Schirra is shown at left during a simulated flight in one of the trainers. From the start of training to the time of his flight he had logged about 125 hours in the trainers, equivalent to about 83 orbits around the earth. Above, Schirra is seen in full pressure suit as he stands in the entrance to the altitude chamber in Hangar S. In his hand is the portable air conditioner used by the astronauts to maintain constant temperatures in the suit prior to being connected to the spacecraft's environmental system.

THE WHITE ROOM at Hangar S, at the right, is the hub of activities for many of the tests run on all Project Mercury spacecraft by the astronauts, NASA and McDonnell engineers. The White Room is air-conditioned and dust filtered to prevent contamination of the delicate systems of the spacecraft. Above, Schirra practices top egress during a training exercise in the White Room.



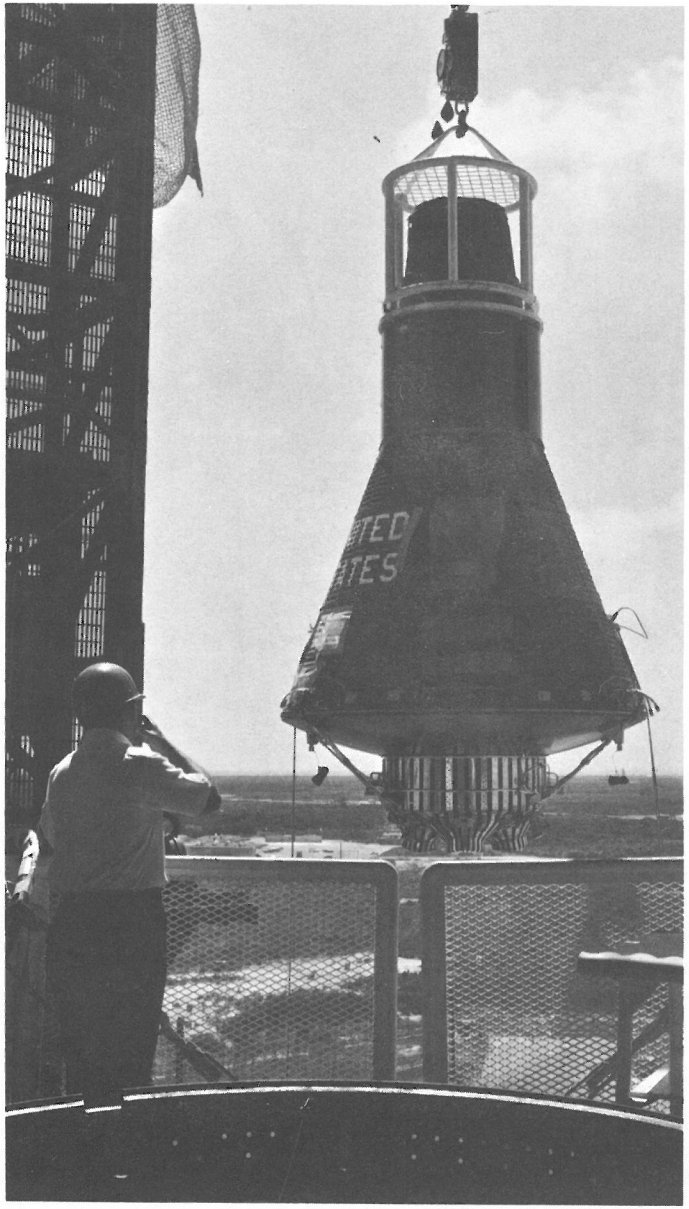
THE ATLAS launch vehicle 113-D is shown at left during erection on August 13 on launch pad 14. Below it is shown in static test firing during preflight verification of its systems.

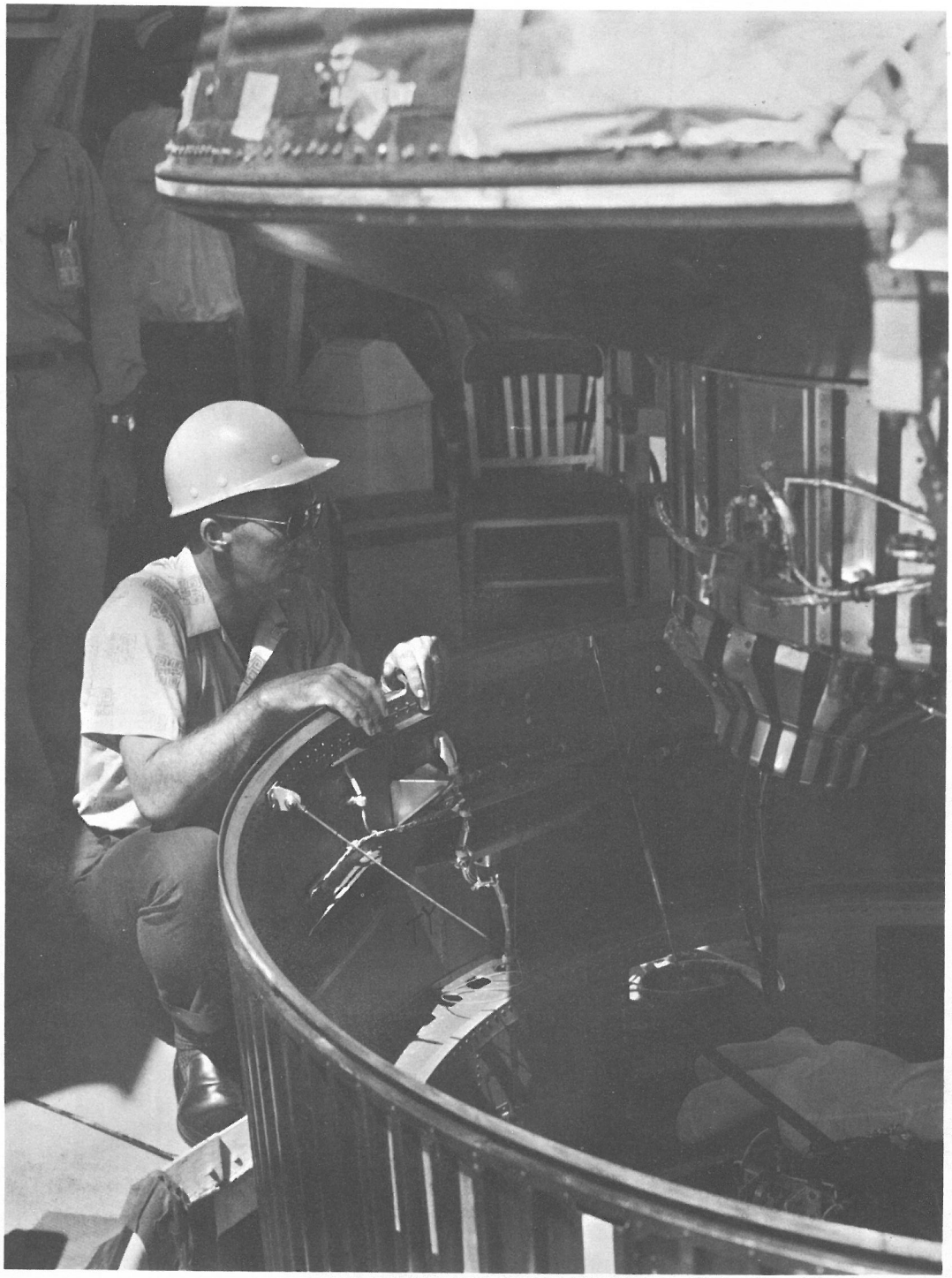


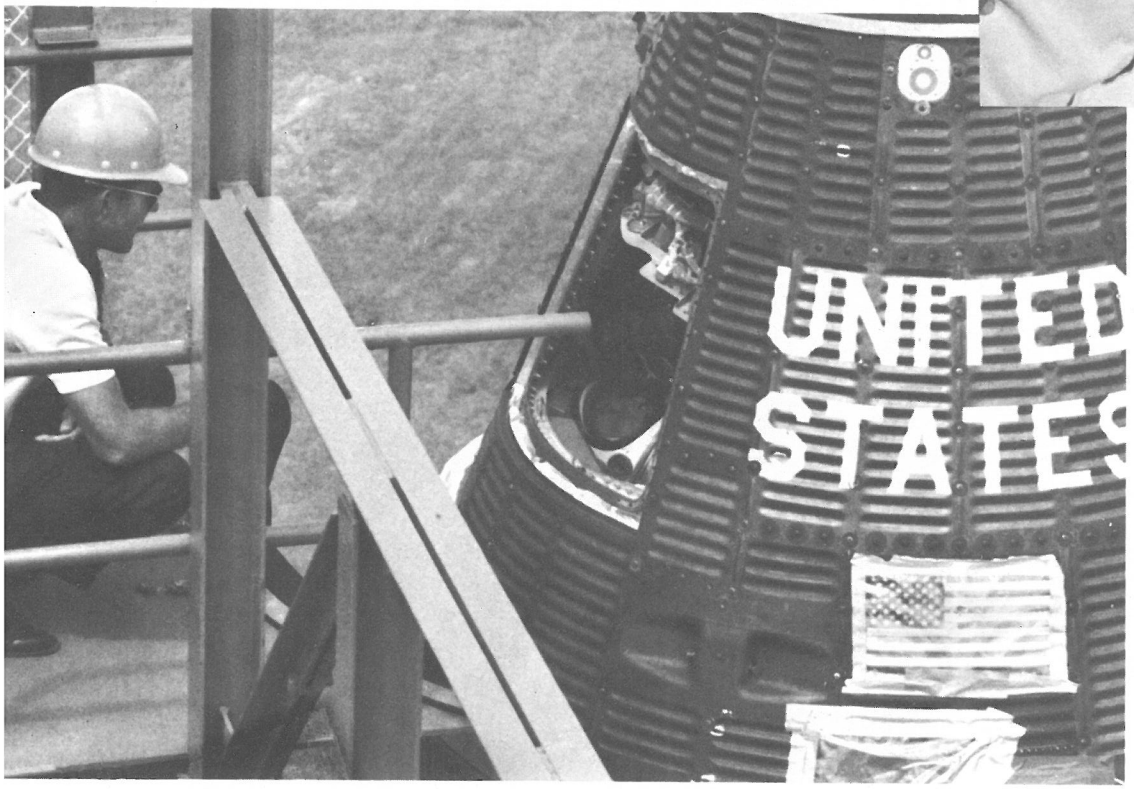


CHATTING WITH ENGINEERS, Schirra waits for a test in the White Room, upper left, and at left he is shown on the weight and balance scale in that same location. Above, back-up pilot Cooper assists Schirra (in spacecraft) during one of the many White Room tests.

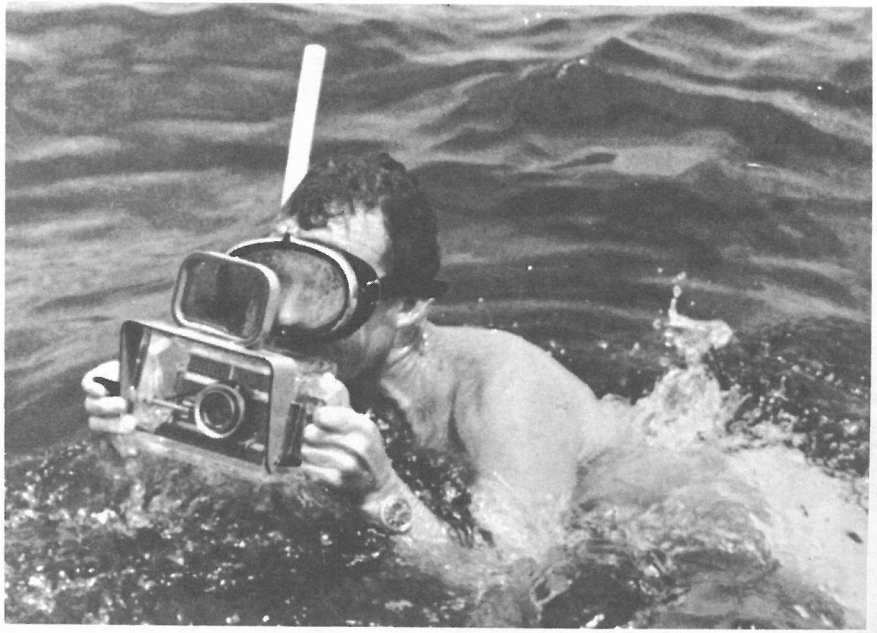
THE SIGMA 7 SPACECRAFT is hoisted to the 11th deck of the gantry at Pad 14 to be mated with the Atlas 113-D launch vehicle, below. At the right, mission pilot Wally Schirra watches the mating process at close range.





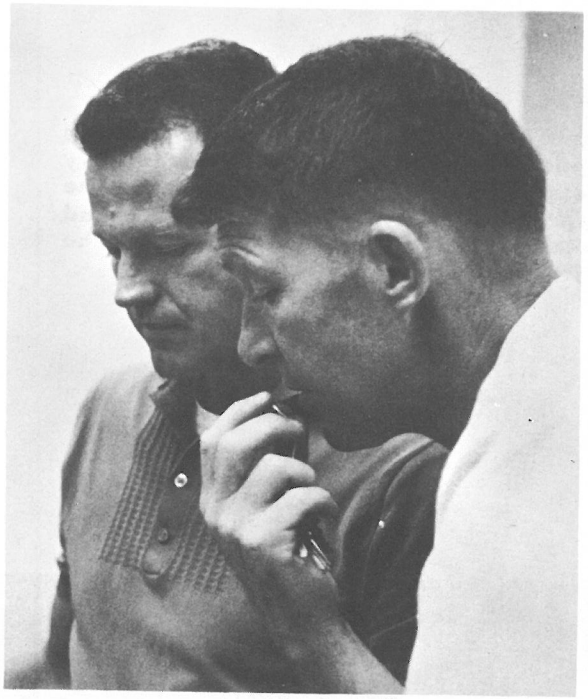


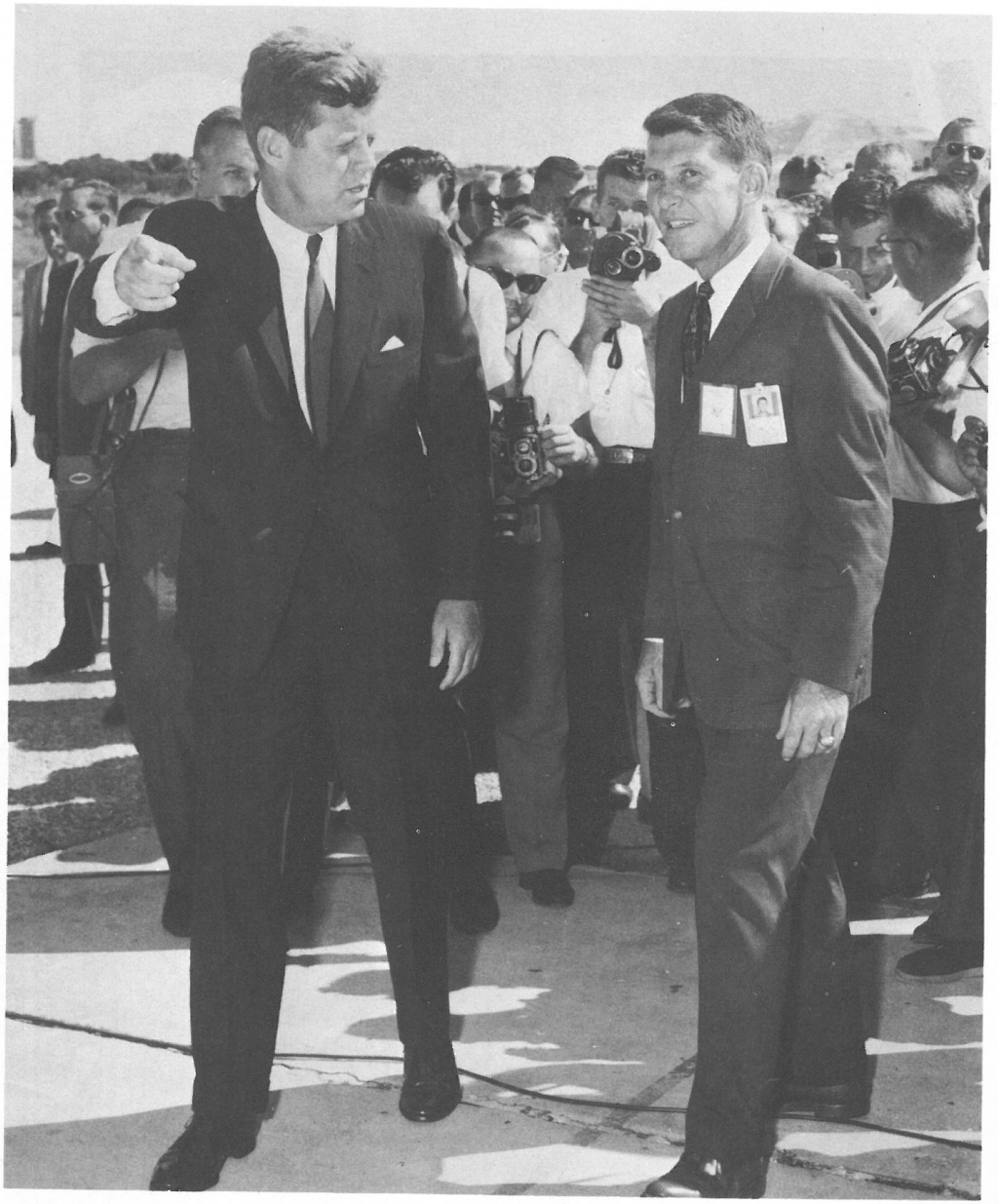
PILOT AND BACK-UP discuss the MA-8 mission in the White Room atop the gantry at Pad 14 prior to the last full scale simulated flight, above, and at the left, Cooper checks with Schirra, in the Sigma 7 spacecraft, during the simulation which followed.



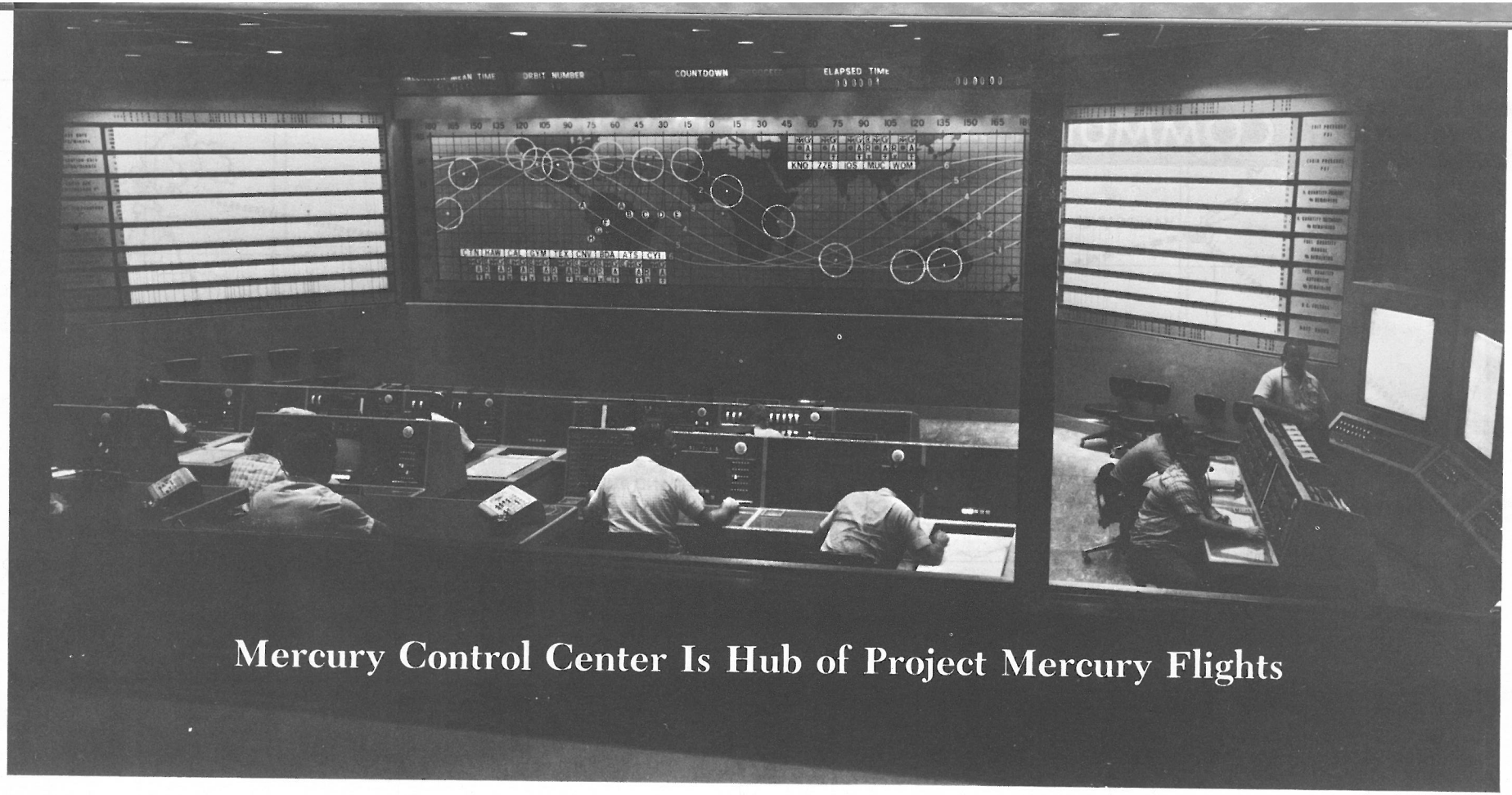
WATER EGRESS TRAINING was practiced by Schirra, above, even though it was not necessary to the success of his flight due to the pinpoint accuracy of the MA-8 mission. During the egress practice his back-up pilot, Gordy Cooper, was busily engaged recording part of the activity with an underwater camera, right.

ARTIST CECE BIBBY puts the finishing touches to the painting of the Sigma 7 insignia on the spacecraft which was to carry Schirra on his successful six-orbit flight, as Schirra, on the right, smiles his approval of the job. Below, the pilot and astronaut nurse Dolores "Dee" O'Hara are shown in the transfer van on the way to Pad 14 for a test.





THE MA-8 MISSION PILOT took time out from training to serve as escort to President Kennedy during his visit to Cape Canaveral in September, above. At upper left, Schirra and Cooper are caught in a studious mood; and at the left, Wally and Flight Director Chris Kraft go over the fine points of the flight plan.



Mercury Control Center Is Hub of Project Mercury Flights

During every major Project Mercury launch, the attention of 15 NASA flight controllers is focused on dozens of consoles and wall displays in the Operations Room of Mercury Control Center at Cape Canaveral, Fla. This room is the control point for all information that flows through the world-wide tracking and communications system. It is in this room that NASA flight controllers make all vital decisions required and issue or delegate all commands.

The communications network carries telephone, teletype and high-speed data (1,000 bits per second) information. It can accept a message from a distant site and deliver it to the final destination—regardless of location along the network—in a little over one second.

Radio teletype facilities use single sideband transmitters, which are less susceptible to atmospheric interference. All circuits, frequencies and paths were selected only after a careful study of data accumulated by the National bureau of Standards on the various propagation qualities of many radio paths.

Submarine cables to London (via New York), to Hawaii (via San Francisco), and to Australia (via Vancouver, B.C.) are included in the Mercury Communications network.

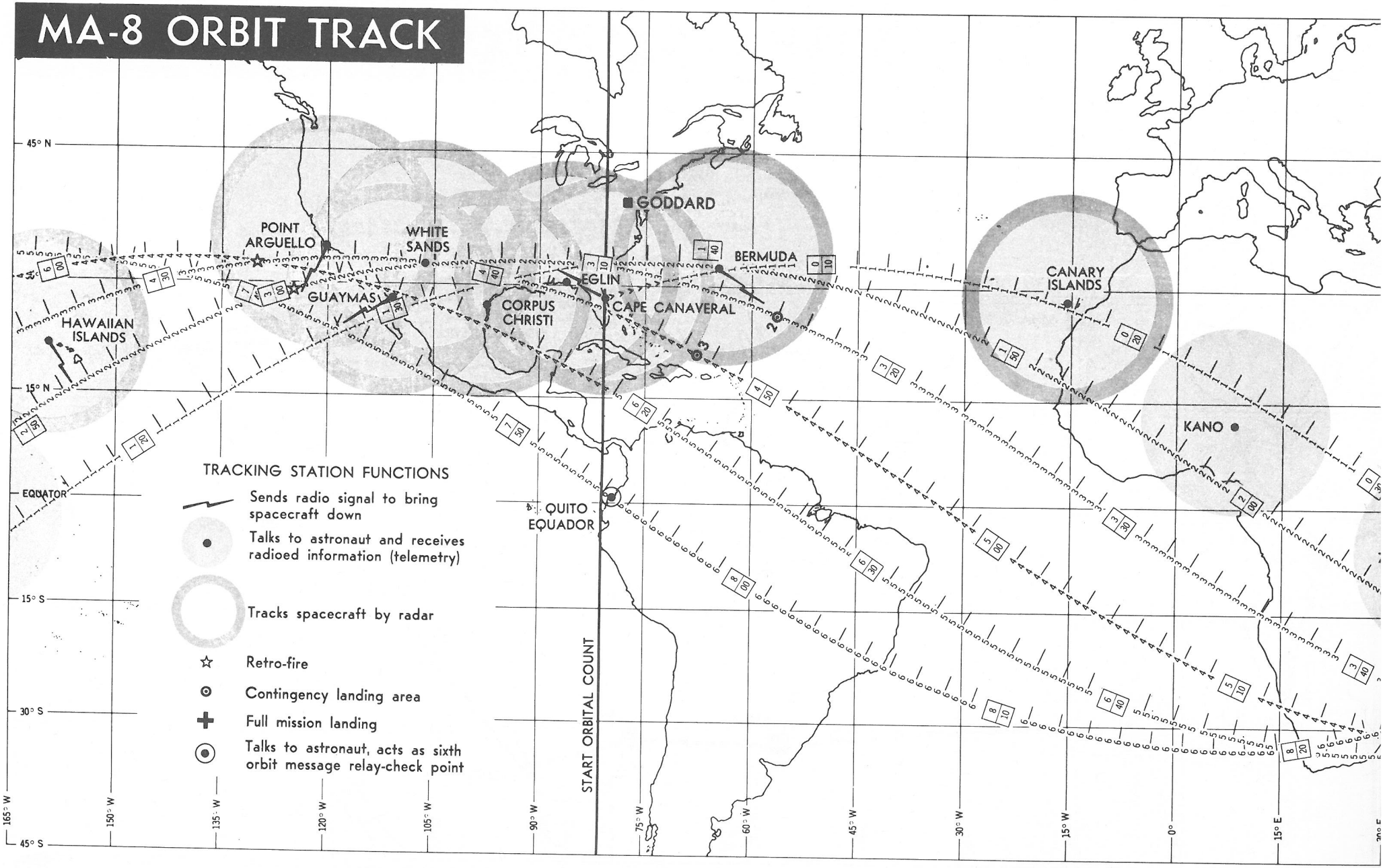
The Mercury Voice Network has a twofold mission:

(1) To provide Mercury Control Center with "real time" information from world-wide stations having contact with the orbiting spacecraft.

(2) To provide a rapid means of dealing with emergency situations between Mercury Control Center and range stations during a mission.

The network is essentially a private line telephone system radiating from Goddard Space Flight Center to Mercury Control Center and the project's world sites.

Altogether, the Mercury system involves approximately 60,000 route miles of communications facilities to assure an integrated network with world-wide capabilities for handling satellite data. It comprises 140,000 actual circuit miles—100,000 miles of teletype, 35,000 miles of telephone lines, and more than 5,000 miles of high-speed data circuits.


MA-8 ORBIT TRACK
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30° S
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165° W
150° W
135° W
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90° W
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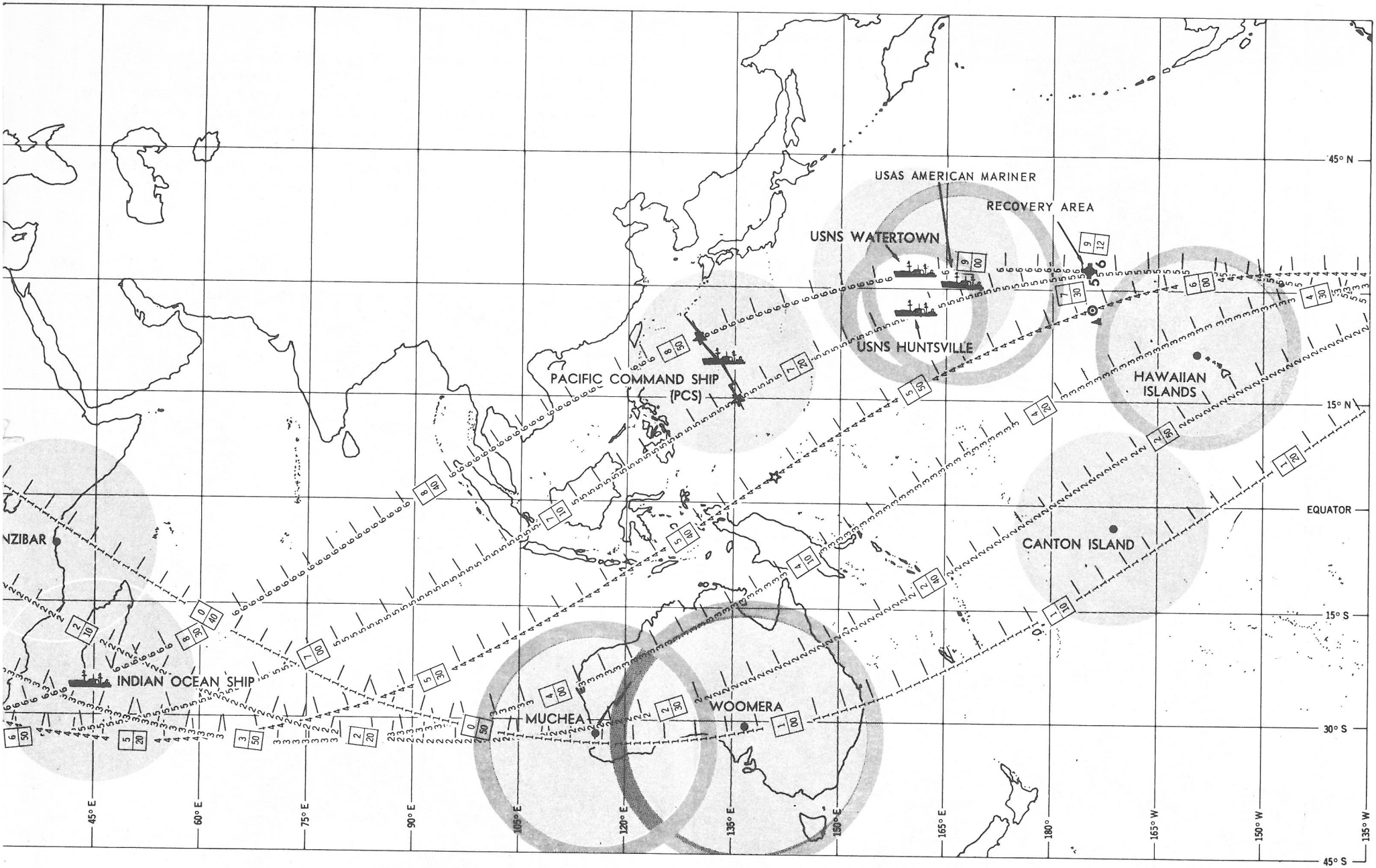
GODDARD
POINT ARGUELLO
WHITE SANDS
BERMUDA
EGLIN
GUAYMAS
CORPUS CHRISTI
CAPE CANAVERAL
CANARY ISLANDS
HAWAIIAN ISLANDS
KANO
QUITO
EQUADOR
START ORBITAL COUNT
TRACKING STATION FUNCTIONS
Sends radio signal to bring spacecraft down
Talks to astronaut and receives radioed information (telemetry)
Tracks spacecraft by radar
Retro-fire
Contingency landing area
Full mission landing
Talks to astronaut, acts as sixth orbit message relay-check point


USAS AMERICAN MARINER
RECOVERY AREA
USNS WATERTOWN
USNS HUNTSVILLE
PACIFIC COMMAND SHIP (PCS)
HAWAIIAN ISLANDS
CANTON ISLAND
INDIAN OCEAN SHIP
MUCHEA
WOOMERA
NZIBAR
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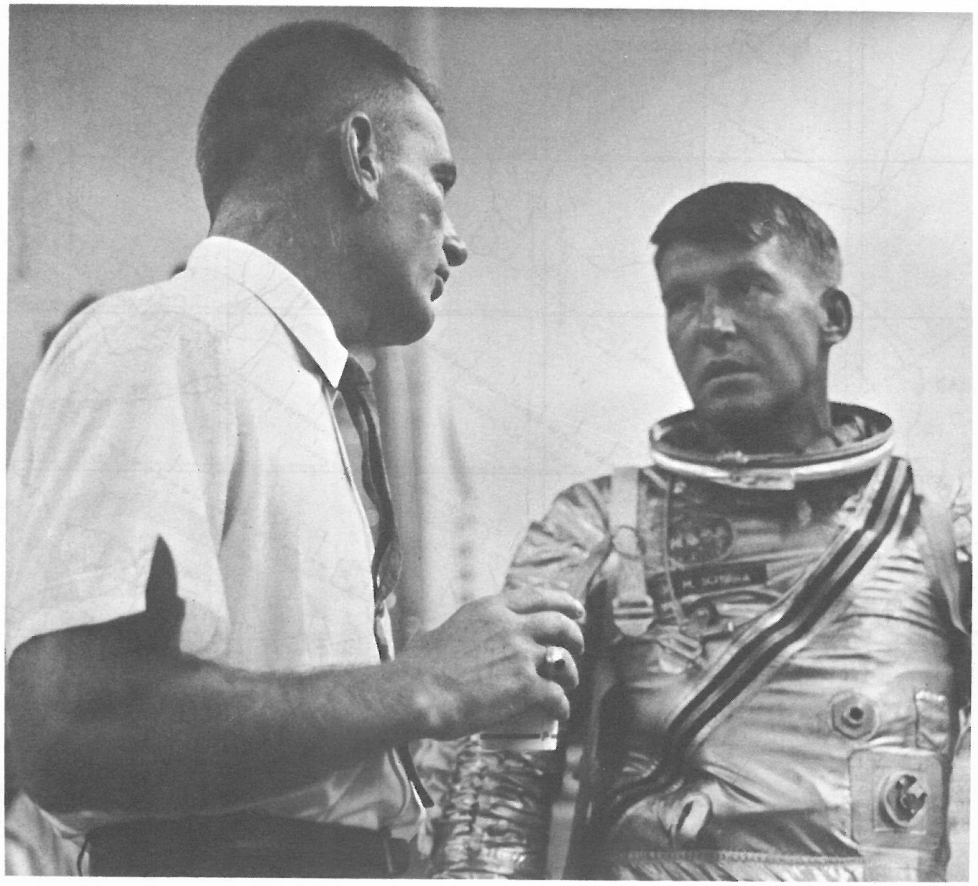
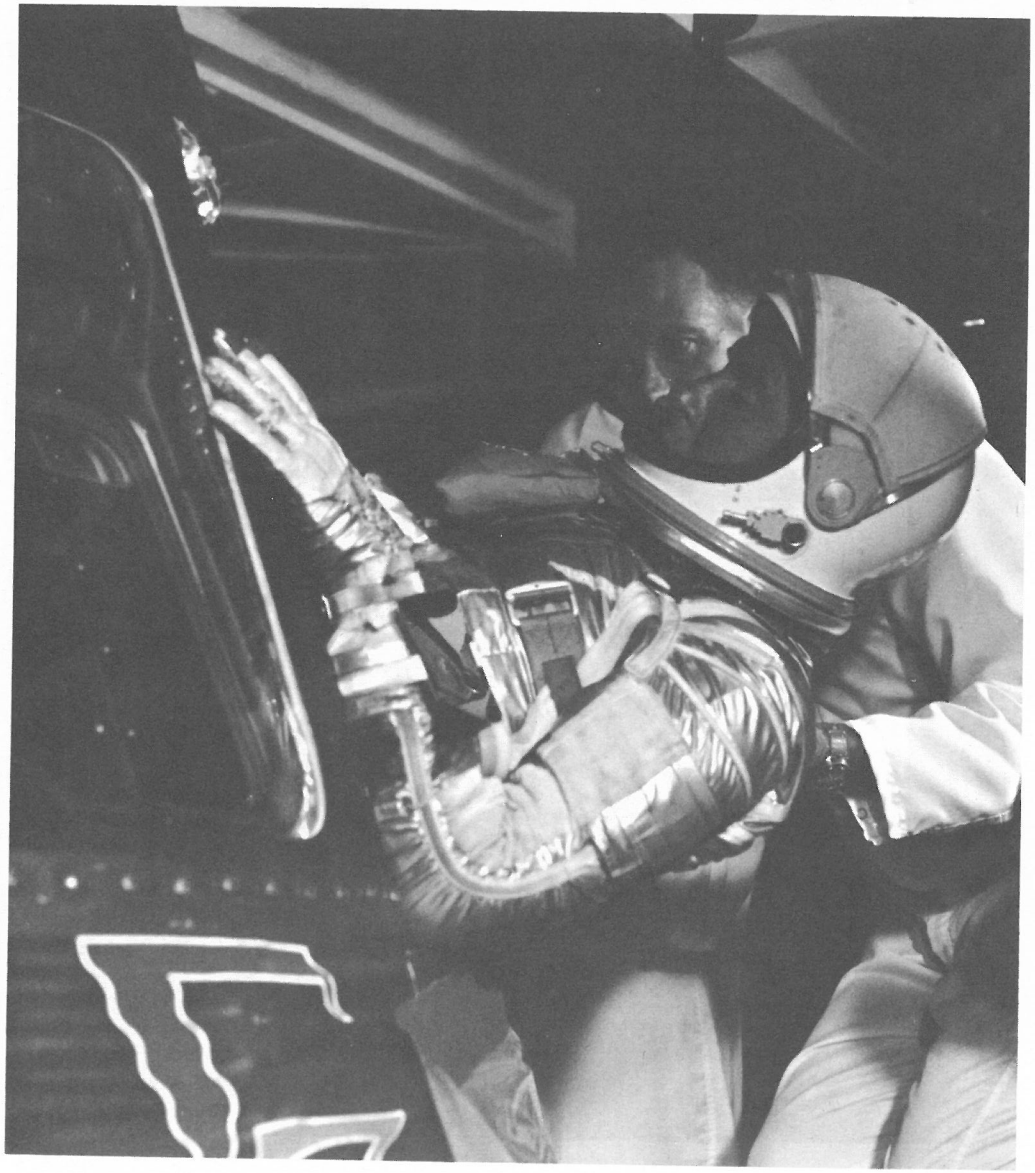
135° E
150° E
165° E
180°
165° W
150° W
135° W

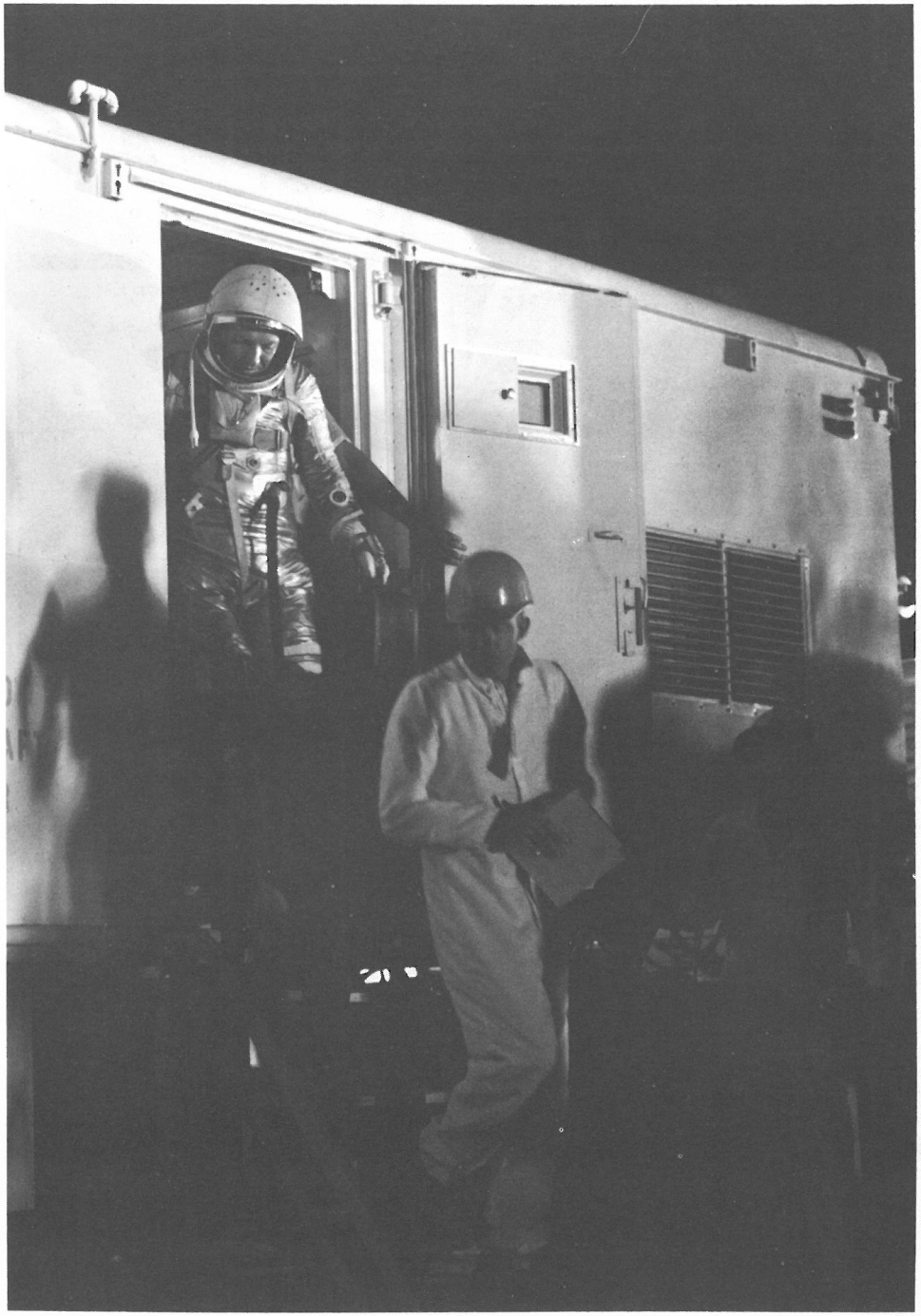
SCHIRRA WAS AIDED in suiting up on the day of the flight by suit technician Al Rochford, at left, an exercise the two had gone through many times in recent months in preparation for the training tests required. Below, Schirra talks to Astronaut Donald K. "Deke" Slayton, while Rochford continues his task. During the actual flight Deke served as capsule communicator at Mercury Control Center and, during the flight, had the sole voice contact with the pilot while he was within range of MCC.



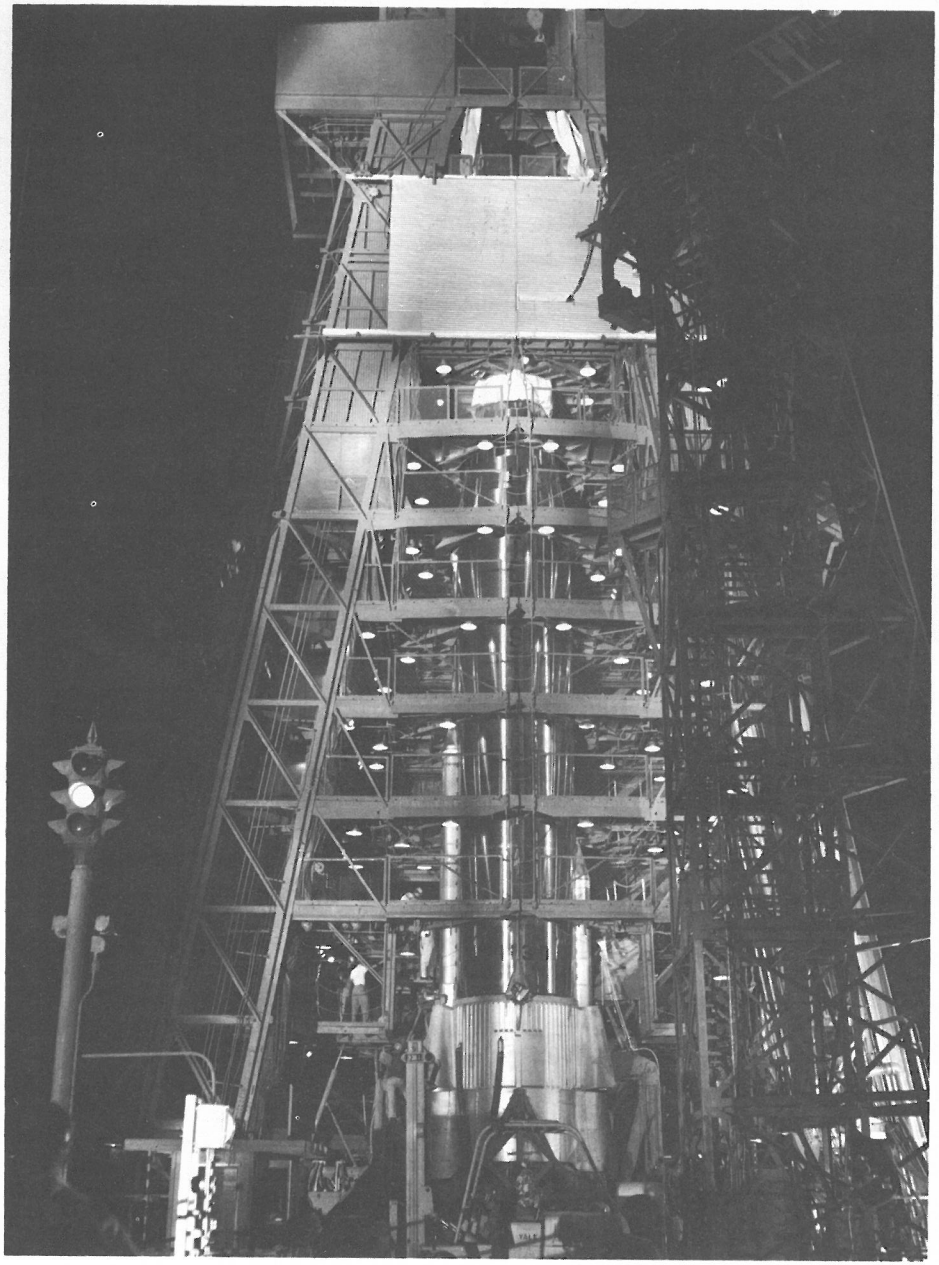
SCHIRRA IS SHOWN at the left as he steps off the elevator, prior to entering the Sigma 7 for his historic six-orbit flight, with the smile on his face indicating his confidence in his mission. Below, Cooper helps insert Schirra into the spacecraft, as the final phases of the countdown were about to begin.

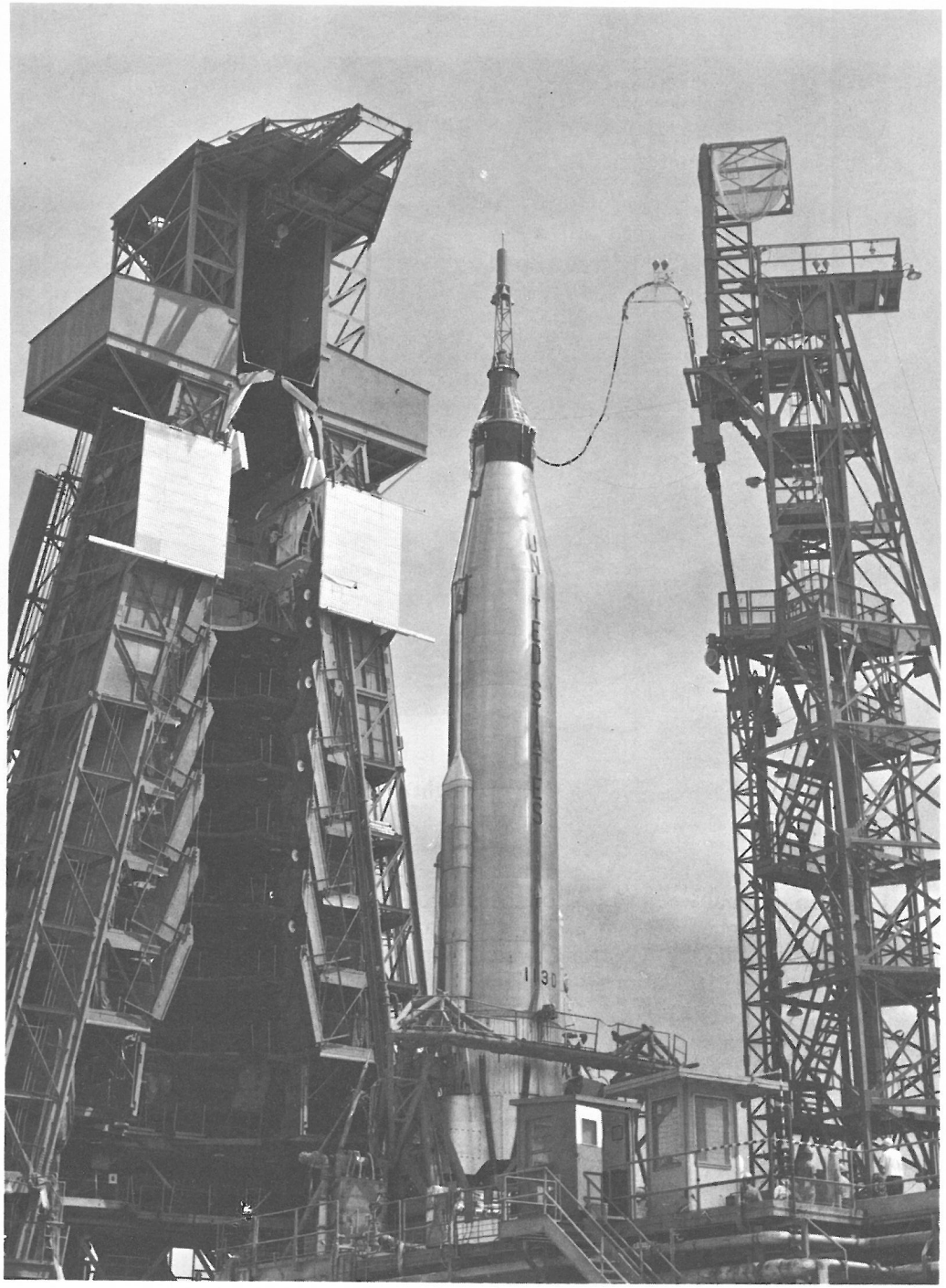


DEPARTING FROM HANGAR S at 4:04 a.m., Schirra was followed to the transfer van by, left to right, suit technicians Joe Schmidt and Al Rochford and Astronaut Flight Surgeon Dr. Howard A. Minners. The van arrived at Pad 14 at 4:29 a.m., and at 4:37 a.m., he stepped out of the van, right, and entered the elevator for his ride to the 11th level of the gantry, after receiving the good wishes of B. G. McNabb on behalf of the personnel at the pad.



THE GANTRY, enclosing the 113-D launch vehicle and the Sigma 7 spacecraft, is pictured during the early morning hours on October 3, below; and, at the right, is a picture taken just after daylight as the gantry is pulled away in the final phases of the countdown.



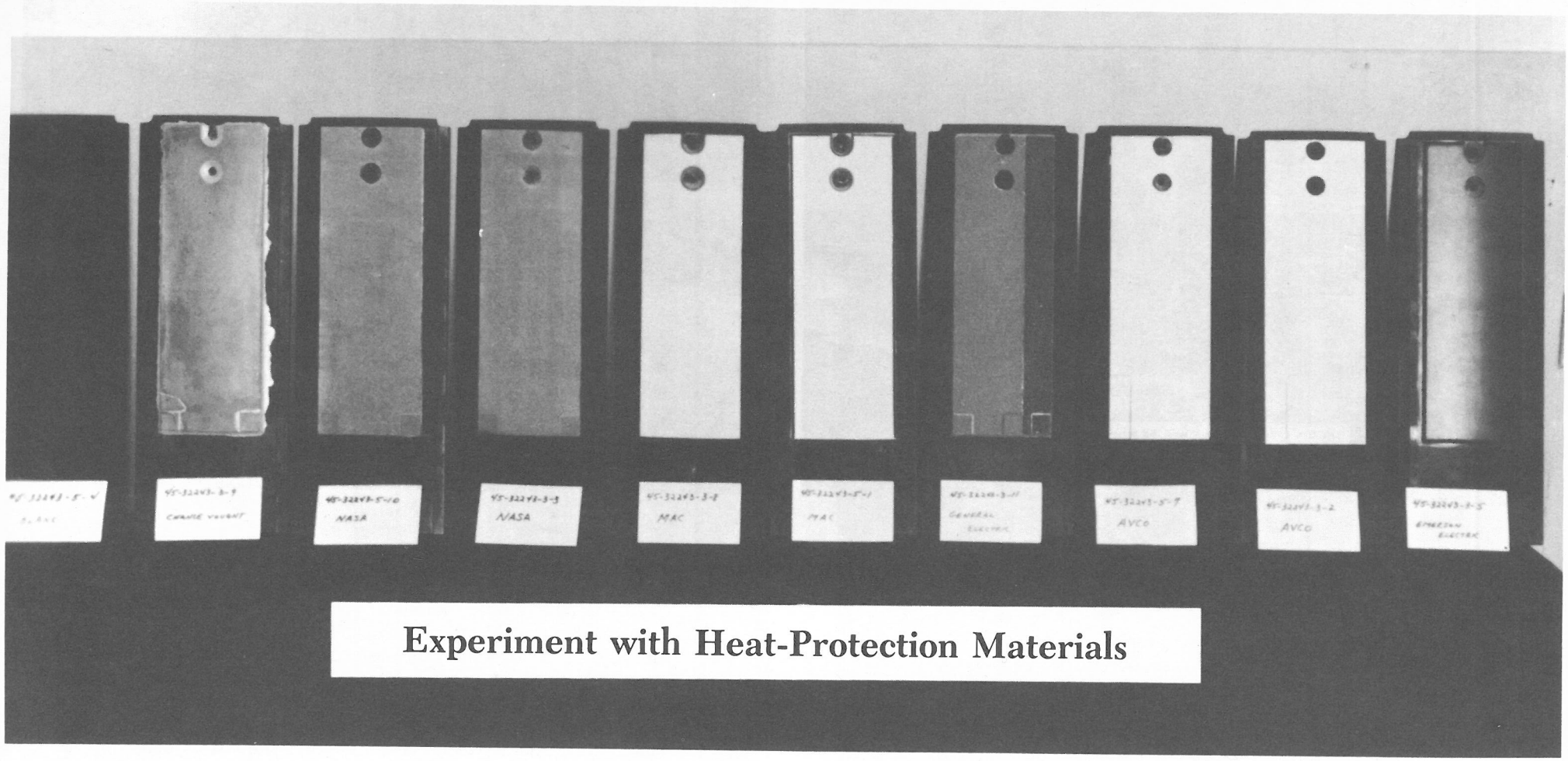


Schirra is pictured above with (left to right) Paul Backer, Deke Slayton and Roland Williams as he examined the hand-held camera used on the MA-8 flight. Williams was responsible for the modification of the Hasselblad camera used on the flight. From an original weight of 52 ounces, unloaded, it was modified so that it weighed 40 ounces loaded. It also featured a special sight, developed by Polaroid, which consisted of converging colored circles. It had an 80-mm lens and used 120 film.

A secondary priority experiment scheduled for the Mercury-Atlas 8 flight concerned taking photographs of terrestrial features and weather phenomena.

The purpose of the scheduled experiment was to build up a catalogue of space acquired photos of physiographic features such as folded mountains, volcanic fields, and glaciers. Due to excessive cloud cover over portions of the earth scheduled for such photography, this phase of the experiment could not be completed.

He did however take some extraterrestrial photographs of weather phenomena which will be referred to the U. S. Weather Bureau and to NASA's Goddard Space Flight scientists who are developing the Nimbus weather satellite. A removable five filter mosaic was used to acquire weather pictures in order to determine possible application of those filters to the Nimbus program.



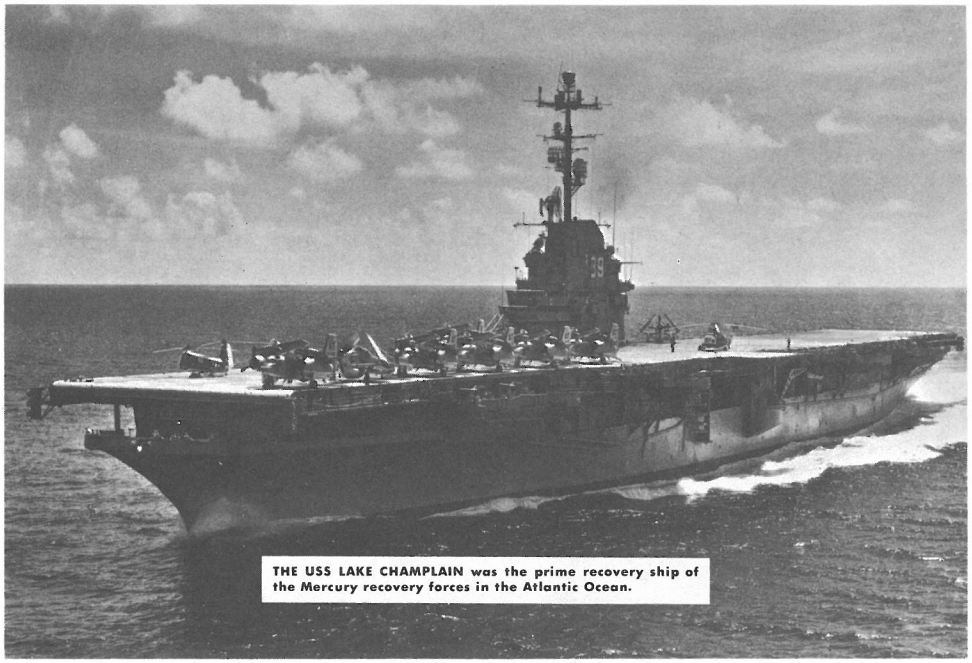
Experiment with Heat-Protection Materials

Another experiment conducted on the MA–8 flight was of a passive nature and was designed to study certain advanced heat-protection materials following exposure to orbital reentry heating.

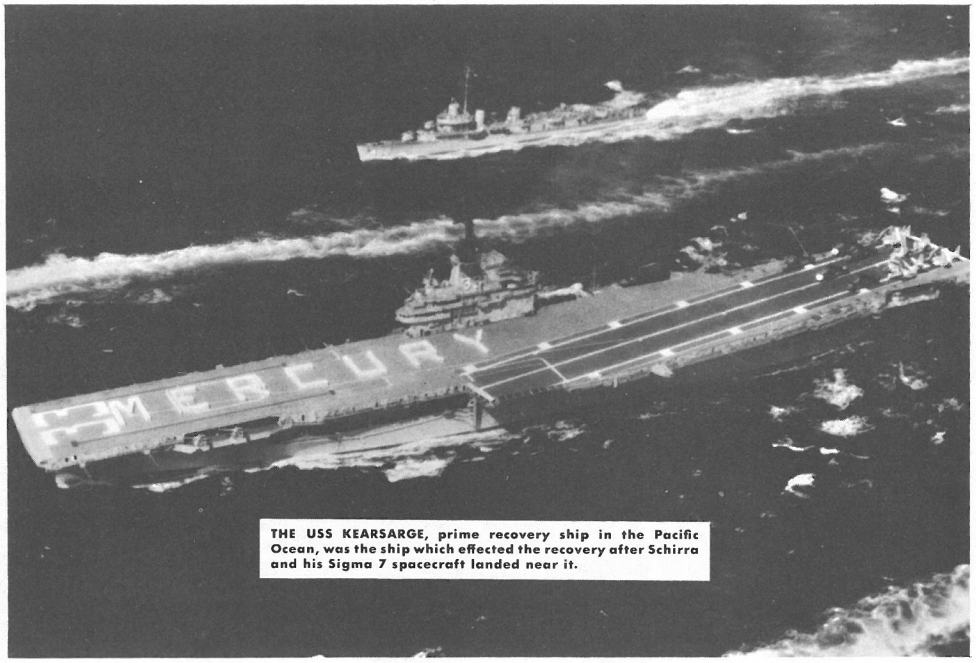
The ablation samples were mounted on the cylindrical neck portion of the spacecraft and were attached through lamination with the external beryllium shingles.

Langley Research Center and five contractors were assigned available panels in order that their respective materials might be tested. They were furnished samples of the beryllium to establish compatibility of their material. All the panels were sent to McDonnell Aircraft Corporation for testing prior to installation on the spacecraft.

In an addition to an evaluation of the reentry heating effects on these materials, discrete cracks were placed in the materials, half of which were filled or repaired. This was done in order to established the effectiveness of heat shield repairs and to provide noncritical damage as a comparison.



THE USS LAKE CHAMPLAIN was the prime recovery ship of the Mercury recovery forces in the Atlantic Ocean.



THE USS KEARSARGE, prime recovery ship in the Pacific Ocean, was the ship which effected the recovery after Schirra and his Sigma 7 spacecraft landed near it.

Recovery Forces for MA-8 Were Far-flung

Department of Defense support of Project Mercury includes global resources of the Army, Navy and Air Force to provide for the recovery of the pilot and spacecraft.

NASA outlined this task to DOD as:

(1) Rapid location of the astronaut and spacecraft;
(2) Safe retrieval of the astronaut and provision for such medical care and assistance as might be necessary; and
(3) Collection, preservation and rapid transmittal of information pertaining to the recovery operation, test data, and test hardware.

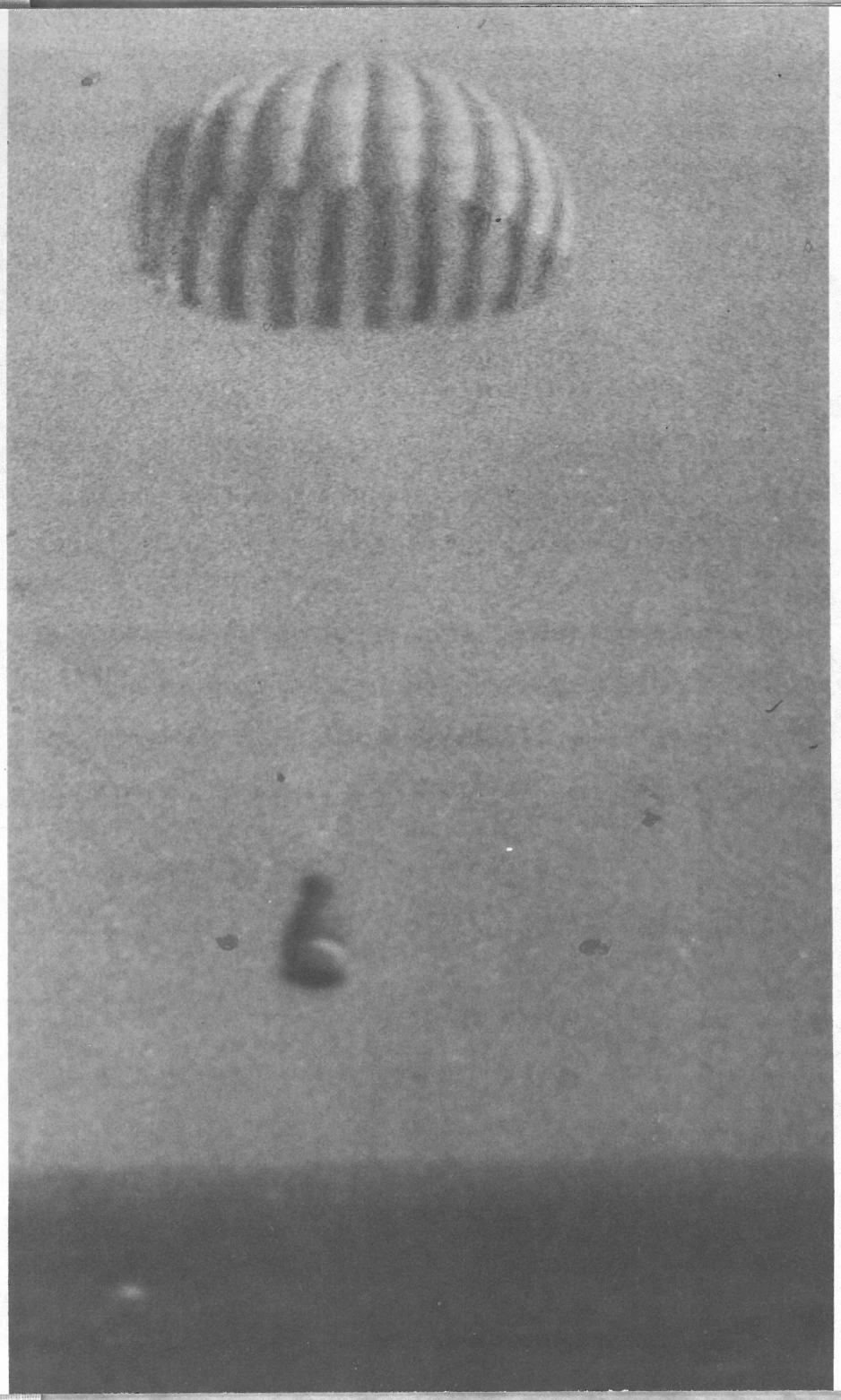
In order to accomplish this mission for the MA-8 flight, 26 ships, 143 aircraft and helicopters, and 17,000 personnel were assigned in direct operational support. In addition, there were standby and alert forces from many theatres and special commands around the world, ready to swing into action in the event of a contingency landing anywhere along the orbital path.

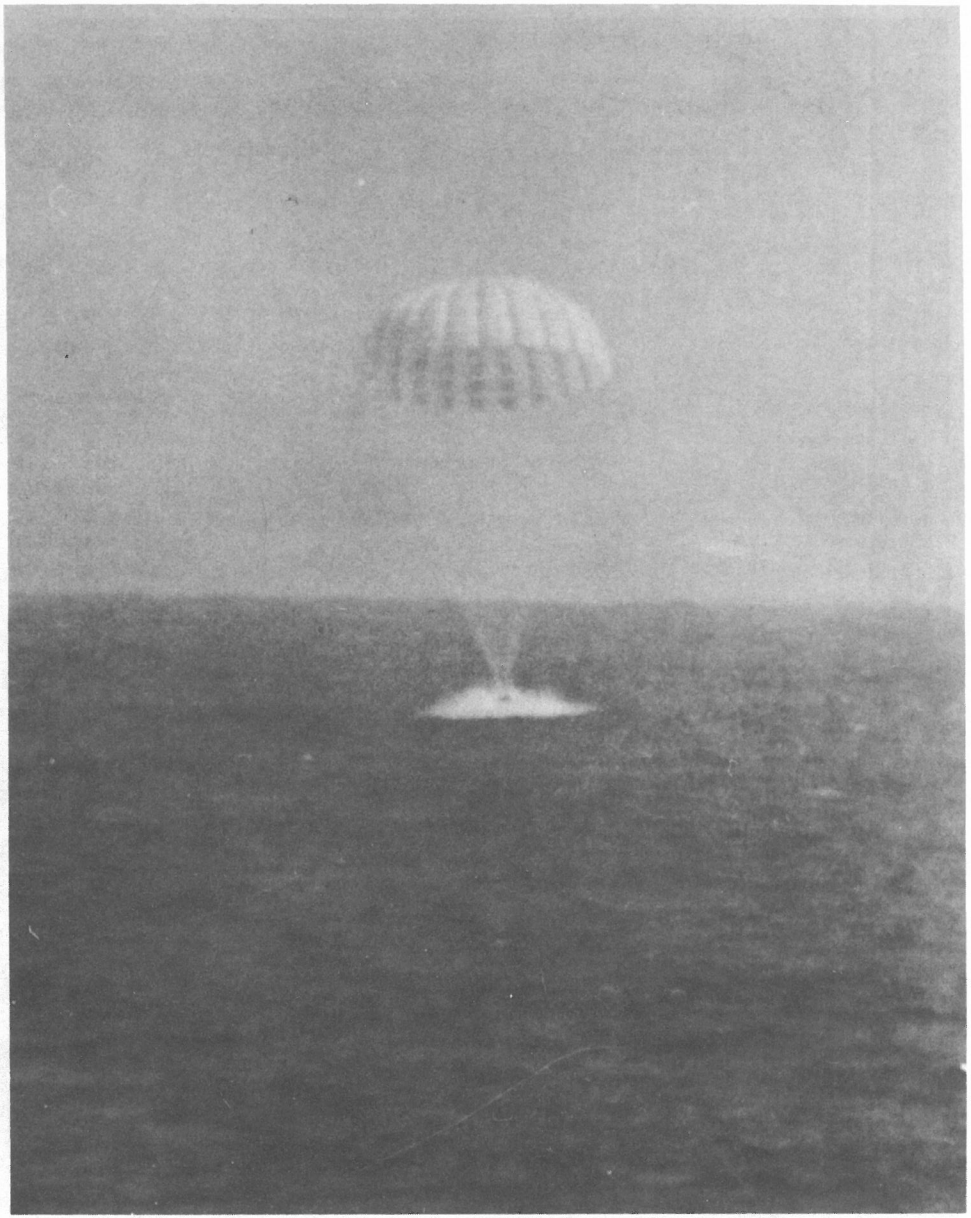
In the Atlantic recovery area, 19 ships and more than 50 aircraft were ready to go into action should the mission be terminated there. Three United States ships—the Hoist, Affray and Alacrity—were stationed just off Cape Canaveral in the event of an abort.

In the event the spacecraft was successfully launched but failed to go into orbit, 10 ships were strategically placed in six recovery areas between Cape Canaveral and Canary Island. They were the United States destroyers Haynesworth, Decatur, Willard Keith, Ingraham, C. S. Sperry, Furse, Norris, Henley, and Dupont and the oiler, USS Kaskaskia. Other ships stationed along the Atlantic path of the spacecraft for orbits two, three, and four were the destroyers USS Bordelon, C. F. Adams, Barry, J. P. Jones, and Warrington, and the aircraft carrier the USS Lake Champlain.

Ships in the Pacific recovery force at the end of orbit four were the United States destroyers Walker, Radford and Epperson.

The preselected landing sites for the fifth and sixth orbits were at a point where the orbital tracks crossed, therefore, the same ships were utilized for recovery duty there. They were the United States destroyers Renshaw, Phillip, and O'Bannion, and the aircraft carrier USS Kearsarge.

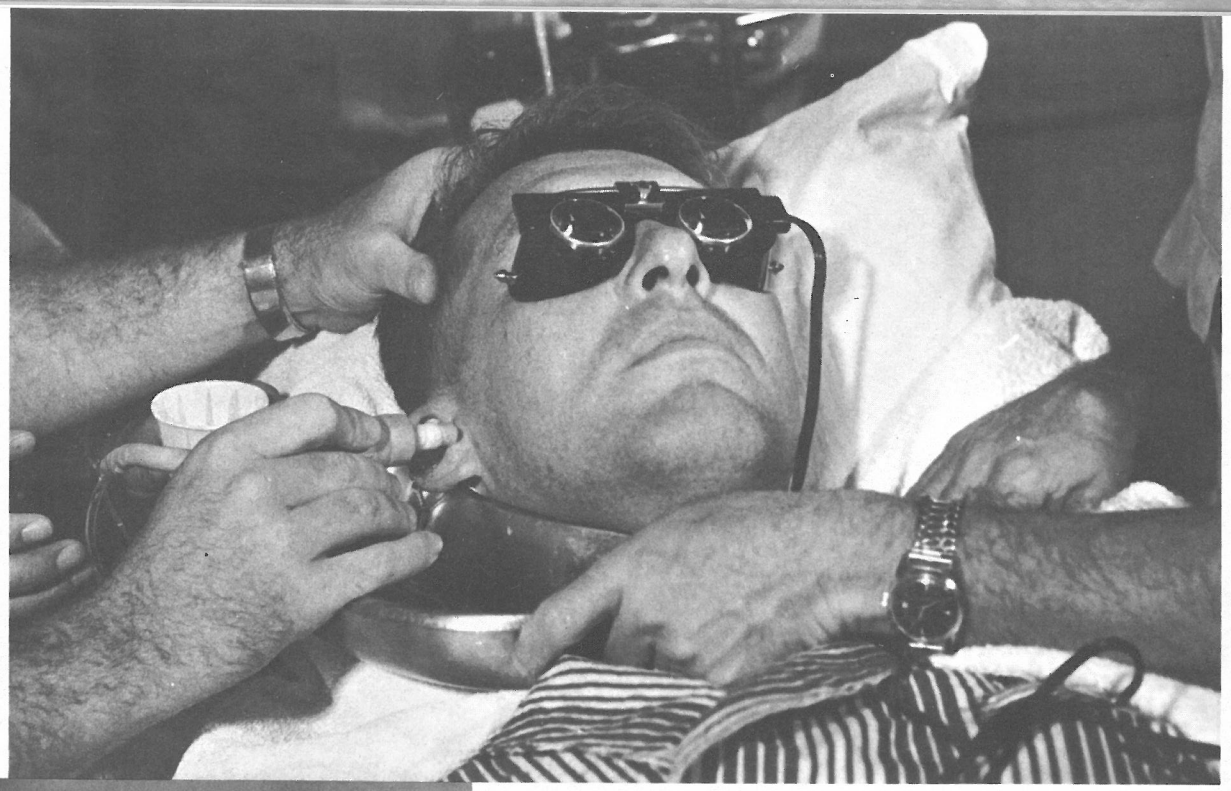


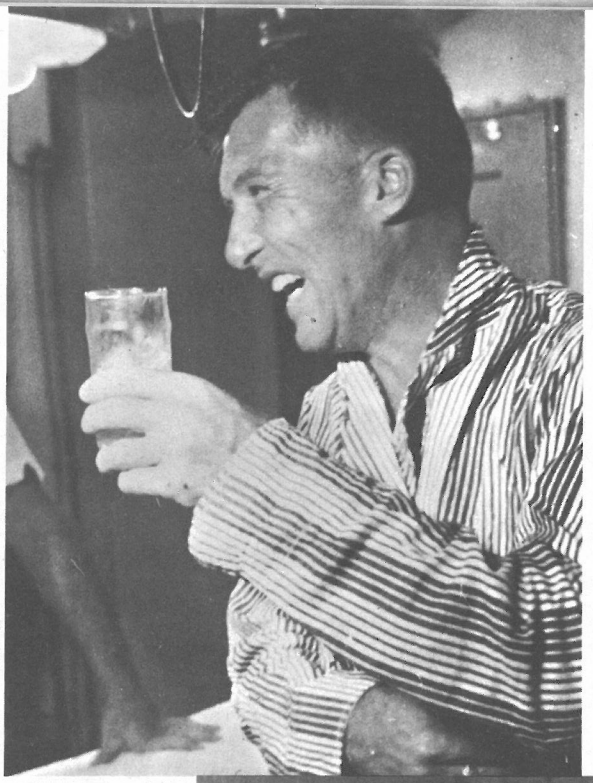


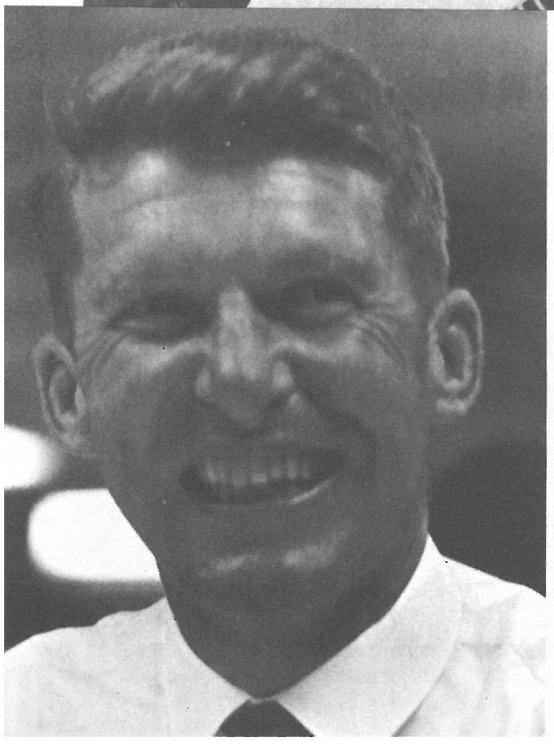
THE FIRST PICTURES ever recorded on an orbital Project Mercury spacecraft landing are shown on this page. At the left, the Sigma 7, with Wally inside, is shown as it nears its landing in the Pacific Ocean, and, above, it is shown at the moment of splashdown.

UNITED
STATES

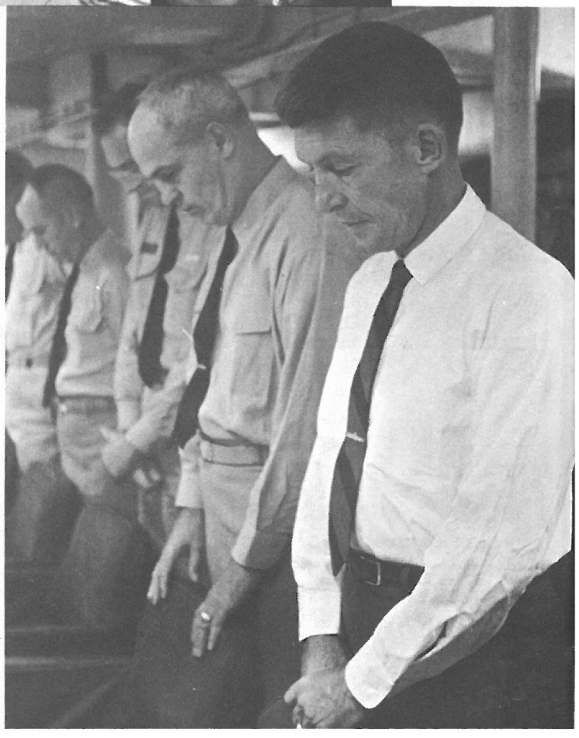
SIGMA 7, MINUTES after impact, is shown upper left on the page at the left, with a smoke bomb released, showing the location of the spacecraft. At upper right, a whaleboat attaches a line to the Sigma 7 prior to towing it to the Kearsarge. At lower left, the spacecraft is pictured being lifted to the elevator deck of the ship; and at the right it is lowered on the deck. At upper right Dr. Dick Pollard assists him out of the spacecraft at upper left he smiles on egress, and at lower right he talks to the President on the phone.

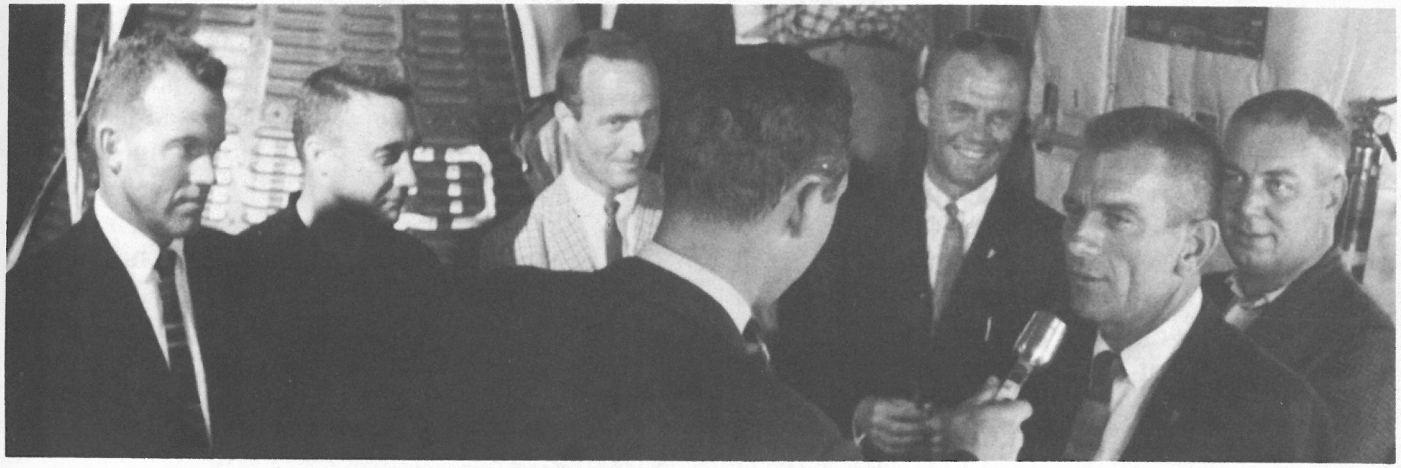


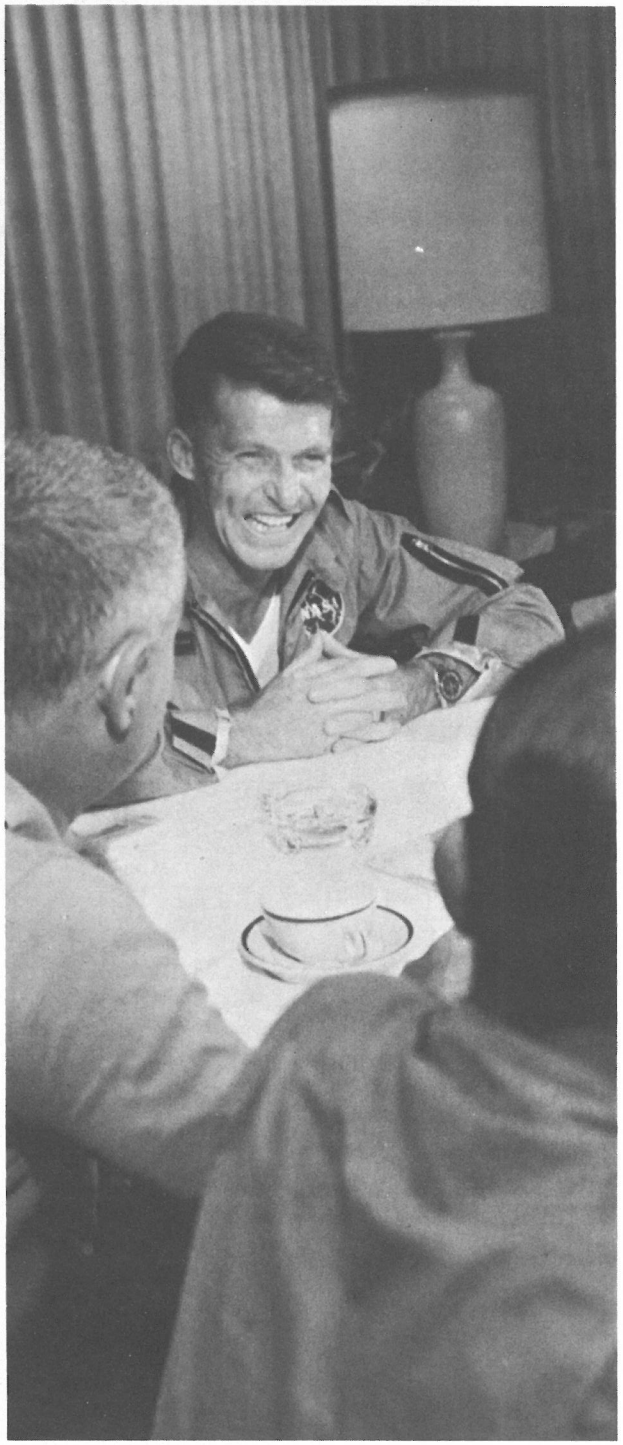




DEBRIEFING WAS CONDUCTED aboard the Kearsarge. Schirra is shown at top left during an early part of the debriefing and at top right he enjoys a glass of orange juice following his trip from Florida. At the left is a candid shot of the happy astronaut and, at the right, proper reverence in displayed before Schirra has dinner with his Navy mates. On the page at the right, upper left, are six key personnel of Manned Spacecraft Center, shown during an interview at Midway Island during their trip to join Schirra aboard the Kearsarge. Left to right are Astronauts L. Gordon Cooper, Jr., Virgil I. Grissom, M. Scott Carpenter, John H. Glenn, Jr., Donald K. Slayton, and MSC's Associate Director, Walter C. Williams. At upper right, Schirra is pictured obviously enjoying a moment during the debriefing with Williams at the left and Public Affairs Officer John A. Powers (back to camera). Lower left, Schirra examines his hand-held camera, and, at the right, a happy space traveler enjoys a bit of earth's air on the deck of the Kearsarge.







Following is a chronology of Project Mercury flight tests to date.

August 21, 1959—LITTLE JOE 1. The first Little Joe firing was cancelled when a faulty wiring circuit prematurely actuated the escape system and carried the spacecraft out over the water. The main chute did not deploy and the spacecraft was destroyed at impact.

September 9, 1959—BIG JOE 1. Purpose of the flight was to investigate re-entry problems and a boiler-plate spacecraft on an Atlas launch vehicle was used. The flight accomplished all technical objectives and the spacecraft was recovered. Because of this success a second scheduled similar mission (BJ-2) was cancelled.

October 4, 1959—LITTLE JOE 6. This test, conducted at Wallops Island, Va., checked the Little Joe booster performance. Eight solid propellant rockets were used which developed 250,000 pounds of thrust at lift-off. The mission validated the aerodynamic and structual integrity of the booster and the use of the command destruction system.

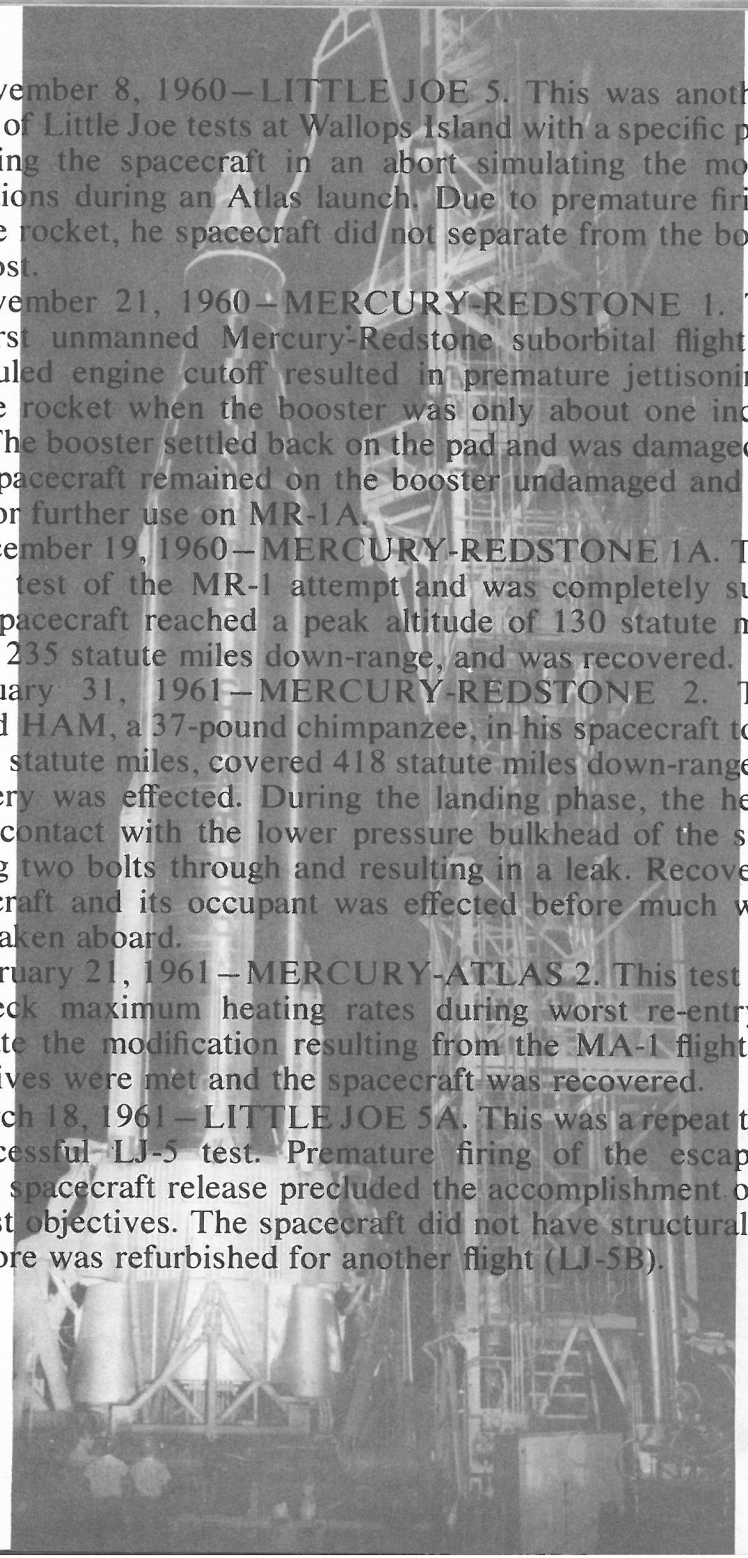
November 4, 1959—LITTLE JOE 1-A. Also tested at Wallops Island to execute a planned abort under high aerodynamic load conditions. The boiler-plate spacecraft was recovered.

December 4, 1959—LITTLE JOE 2. Test flight at Wallops Island to check high-altitude performance of the escape system. A rhesus monkey, SAM, was used as a test subject. All test objectives were met and the spacecraft with occupant was recovered.

January 21, 1960—LITTLE JOE 1-B. Another Wallops Island test to evaluate the escape system under high aerodynamic load. Rhesus monkey, MISS SAM, was a test subject and the spacecraft and occupant were recovered with the test rated as a success.

May 9, 1960—Beach Abort Test. McDonnell's first production spacecraft and its escape rocket system were flight tested in an off-the-pad (Beach Abort) test at Wallops Island to evaluate the escape rocket system. No booster was used. The test was successful and the spacecraft was recovered.

July 29, 1960—MERCURY-ATLAS (MA-1). This was the first Atlas-boosted flight with a production spacecraft. The objectives were to qualify the spacecraft under maximum air loads and afterbody heating rate during re-entry conditions. The spacecraft contained only a minimum number of systems and no escape tower. The test was unsuccessful.



November 8, 1960—LITTLE JOE 5. This was another of the series of Little Joe tests at Wallops Island with a specific purpose of checking the spacecraft in an abort simulating the most severe conditions during an Atlas launch. Due to premature firing of the escape rocket, he spacecraft did not separate from the booster and was lost.

November 21, 1960—MERCURY-REDSTONE 1. This was the first unmanned Mercury-Redstone suborbital flight. An unscheduled engine cutoff resulted in premature jettisoning of the escape rocket when the booster was only about one inch off the pad. The booster settled back on the pad and was damaged slightly. The spacecraft remained on the booster undamaged and was suitable for further use on MR-1A.

December 19, 1960—MERCURY-REDSTONE 1A. This was a repeat test of the MR-1 attempt and was completely successful. The spacecraft reached a peak altitude of 130 statute miles, travelled 235 statute miles down-range, and was recovered.

January 31, 1961—MERCURY-REDSTONE 2. This test carried HAM, a 37-pound chimpanzee, in his spacecraft to a height of 157 statute miles, covered 418 statute miles down-range, and the recovery was effected. During the landing phase, the heat shield made contact with the lower pressure bulkhead of the spacecraft driving two bolts through and resulting in a leak. Recovery of the spacecraft and its occupant was effected before much water had been taken aboard.

February 21, 1961—MERCURY-ATLAS 2. This test was held to check maximum heating rates during worst re-entry and to evaluate the modification resulting from the MA-1 flight. All test objectives were met and the spacecraft was recovered.

March 18, 1961—LITTLE JOE 5A. This was a repeat test of the unsuccessful LJ-5 test. Premature firing of the escape rocket before spacecraft release precluded the accomplishment of most of the test objectives. The spacecraft did not have structural damage, therefore was refurbished for another flight (LJ-5B).

March 24, 1961—MERCURY-REDSTONE BD. This was a booster development test which was successful. The boiler-plate spacecraft used was one previously test flown on LJ-1B which provided the proper configuration and weight. All booster test objectives were met.

April 25, 1961—MERCURY-ATLAS 3. This was the first attempt to orbit a Mercury spacecraft which contained special instrumentation and a "mechanical astronaut." Due to booster guidance malfunction, the booster was destroyed by the Range Safety Officer approximately 40 seconds after lift-off. The spacecraft performed a successful escape maneuver, was recovered and refurbished for the MA-4 test.

April 28, 1961—LITTLE JOE 5B. This was the third test of the escape system under maximum exit dynamic pressure conditions. The test objectives were met and the spacecraft recovered.

May 5, 1961—"FREEDOM 7"—MERCURY-REDSTONE 3. This was the first manned suborbital flight with Astronaut Alan B. Shepard, Jr., as pilot. The spacecraft achieved an altitude of 116.5 statute miles and a range of 302.8 nautical miles. The mission was completely successful.

July 21, 1961—"LIBERTY BELL 7"—MERCURY-REDSTONE 4. This was the second and final manned suborbital flight of the Mercury program. Astronaut Virgil I. Grissom was the pilot. The flight path was approximately the same as in the MR-3 mission. The spacecraft attained a height of 118.3 statute miles and travelled down-range 302 statute miles. The mission was a success except for the recovery phase. Due to premature actuation of the side hatch, water shipped into the spacecraft and made it so heavy the helicopter could not recover it and it sank in 2,800 fathoms of water. Grissom was in the water about four minutes before being rescued but was found to be in excellent condition.

September 13, 1961—MERCURY-ATLAS 4. The unmanned spacecraft successfully made one earth orbit, reaching an apogee of 142.1 statute miles and perigee of 98.9 statute miles. All test objectives were met and the spacecraft was recovered.

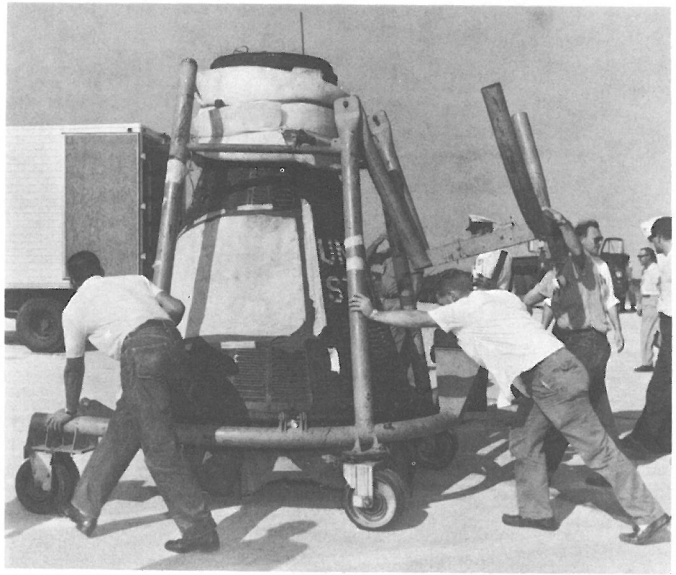
November 1, 1961—MERCURY-SCOUT 1. The purpose of this test was to orbit a communications package in order to additionally evaluate the radar tracking capability of the Mercury Tracking Network. The test was terminated shortly after lift-off due to erratic booster oscillations which continued to increase in magnitude until the missile apparently broke up.

November 29, 1961—MERCURY-ATLAS 5. This flight, with champanzee ENOS aboard, successfully orbited the earth twice before the command to return it to earth was given, due to increasing inverter temperature and other than nominal attitude control. Enos was in excellent condition. Apogee of 147.4 statute miles and perigee of 99.5 statute miles was attained.

February 20, 1962—"FRIENDSHIP 7"—MERCURY-ATLAS 6. This was the first United States manned orbital spaceflight with Astronaut John H. Glenn, Jr., as pilot. The 80,000-mile flight of 4 hours, 55 minutes and 22 seconds duration, completed three orbits of the earth with a perigee altitude of 86.92 nautical miles and an apogee of 140.92 nautical miles. The success of the test showed the need of a human crew in space flights and man's adaptability to the space environment.

May 24, 1962—"AURORA 7"—MERCURY-ATLAS 7. This flight, the second United States manned, three-orbital spaceflight by Astronaut M. Scott Carpenter was approximately the same as MA-6. Perigee altitude of 86.87 nautical miles and apogee of 144.96 nautical miles were reached. The test verified MA-7 observations and results and contributed valuable space science information. It was completed successfully except for a delayed retrofire that resulted in a landing 250 miles beyond the planned recovery area.

October 3, 1962—"SIGMA 7"—MERCURY-ATLAS 8. This flight of six orbits by Astronaut Walter M. Schirra covered approximately 160,000 miles and reached an apogee altitude of 152.8 nautical miles and a perigee of 86.9 nautical miles. The nine hour and 13 minute mission was terminated in the Pacific by a pinpoint landing in the center of the prime recovery area approximately 270 statute miles North East of Midway. The test of man's capabilities in space environment and the engineering concepts of the spacecraft and supporting systems was completely successful.



THE SIGMA 7 spacecraft is seen at upper left after being loaded on an Army LARC at the skid strip after its return to Cape Canaveral. At upper right, the LARC pulls up to Hangar S with its orbital load, and at left it is loaded on a dolly. At the right, the spacecraft is shown in front of Hangar S, its point of departure for the 160,000 mile, nine hour journey.

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ASTRONAUT WINGS were pinned on Schirra by Secretary of the Navy Fred Korth as his wife, Jo, looked on, in a ceremony at the Pentagon October 16.

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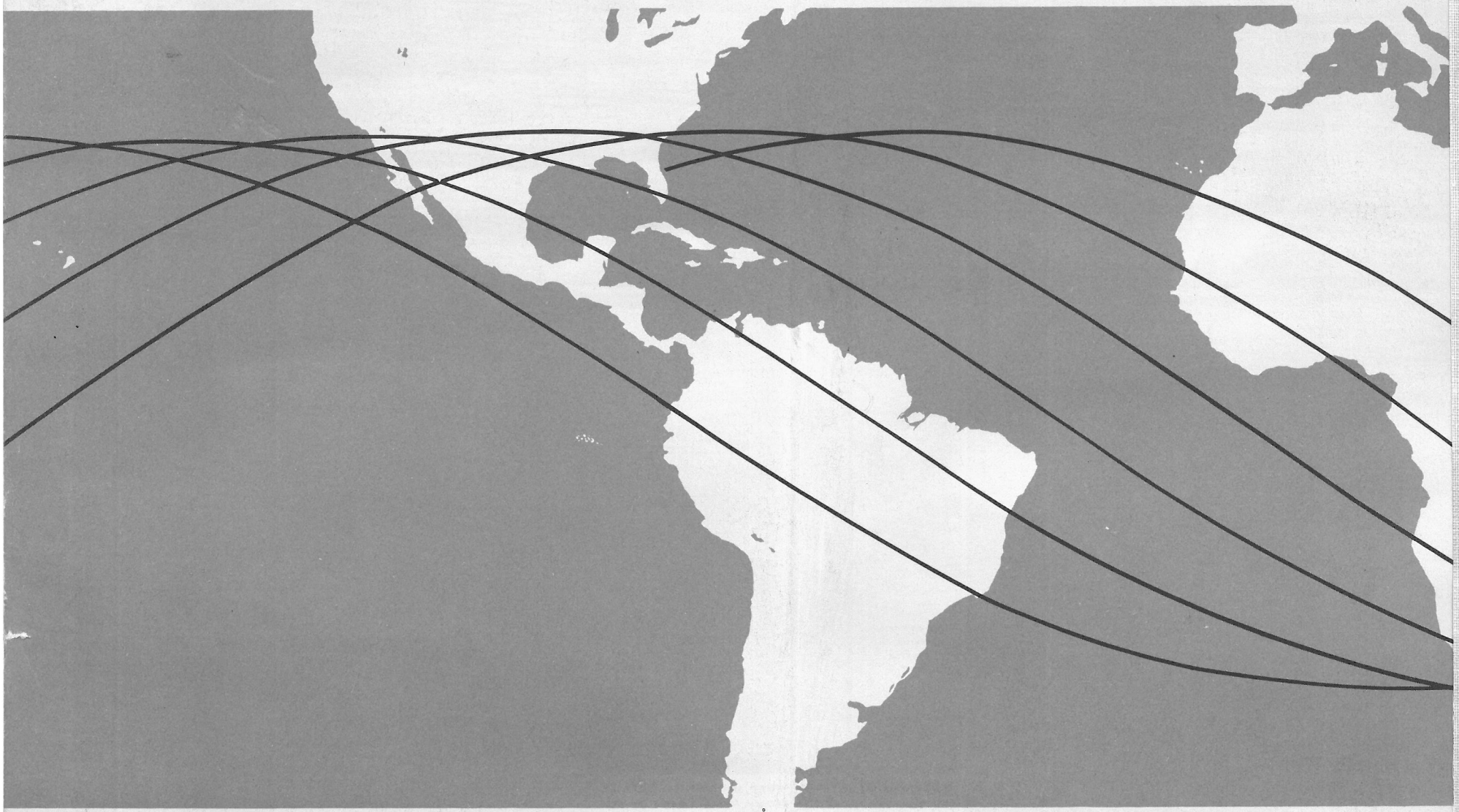

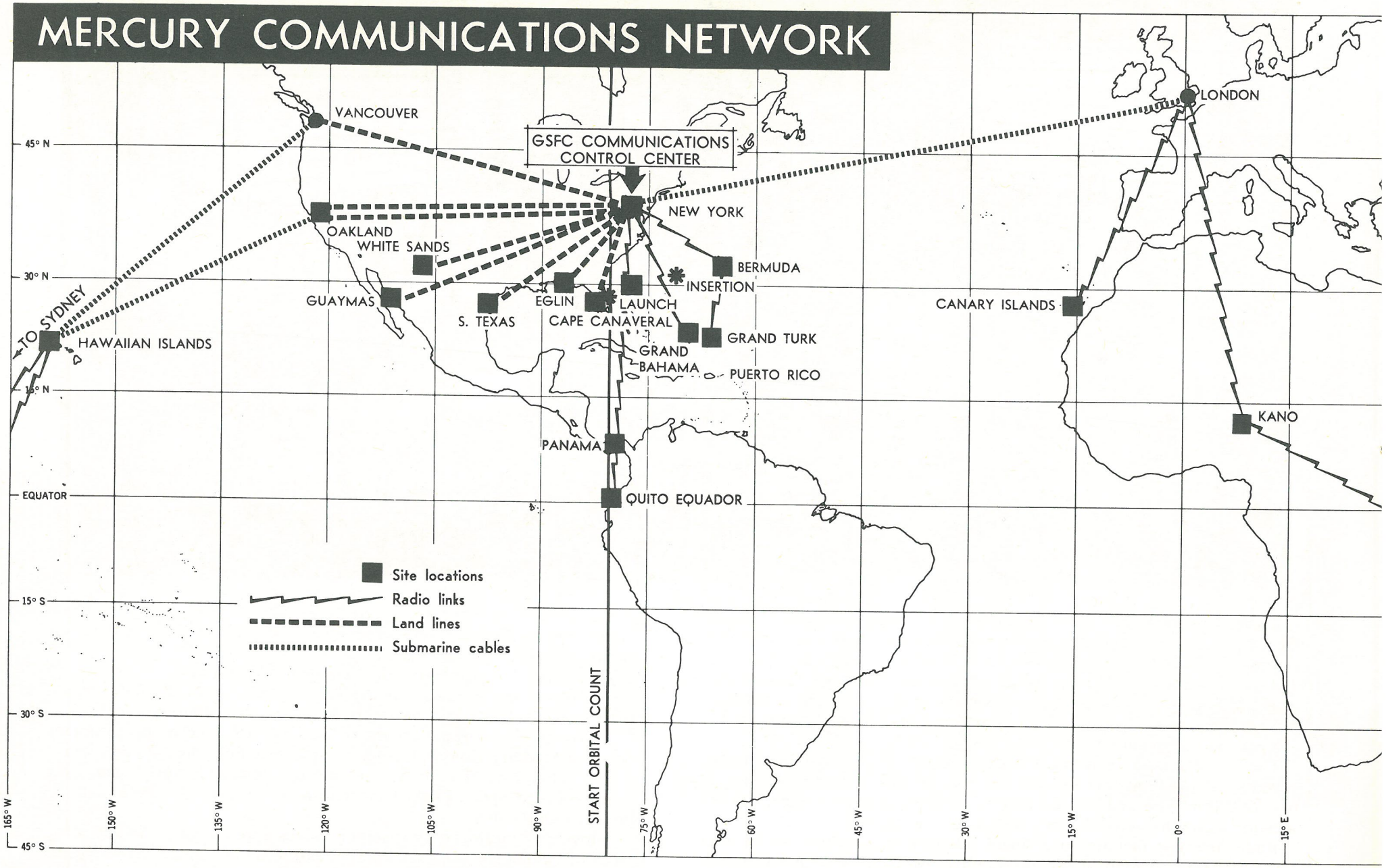
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GSFC COMMUNICATIONS CONTROL CENTER
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NEW YORK
OAKLAND
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INSERTION
GUAYMAS
EGLIN
LAUNCH
CANARY ISLANDS
TO SYDNEY
S. TEXAS
CAPE CANAVERAL
GRAND TURK
HAWAIIAN ISLANDS
GRAND BAHAMA
PUERTO RICO
KANO
PANAMA
QUITO EQUADOR
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Radio links
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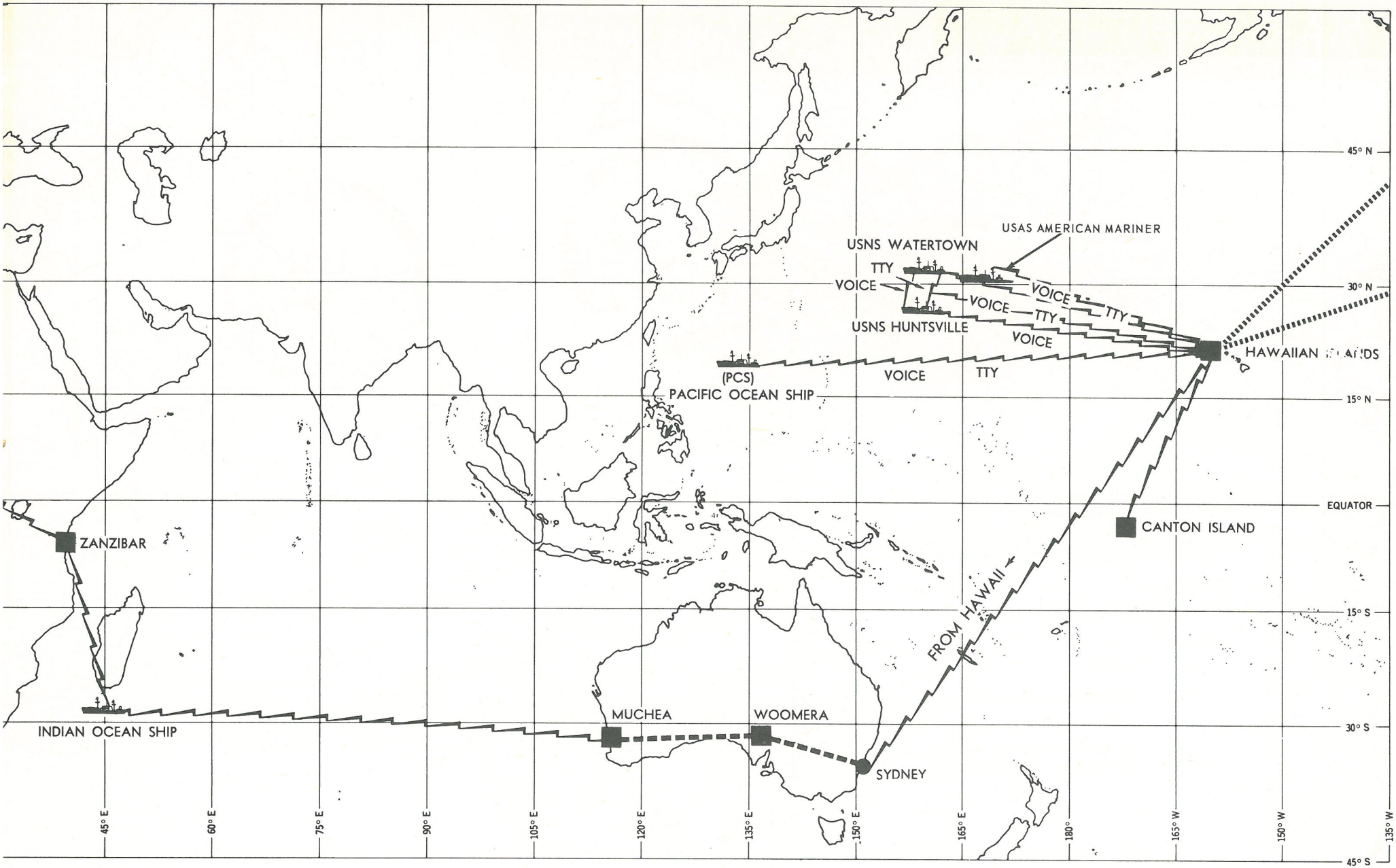
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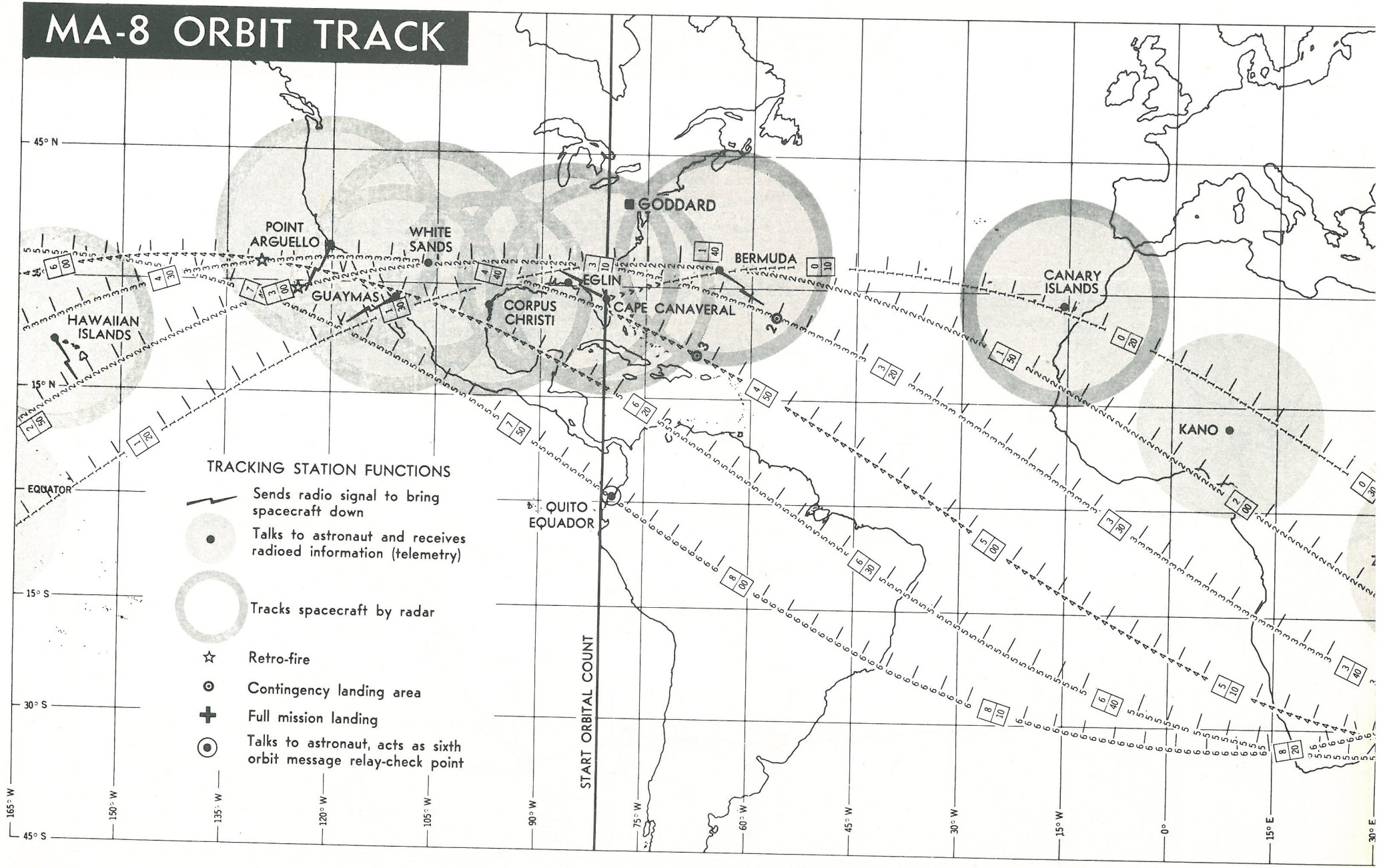
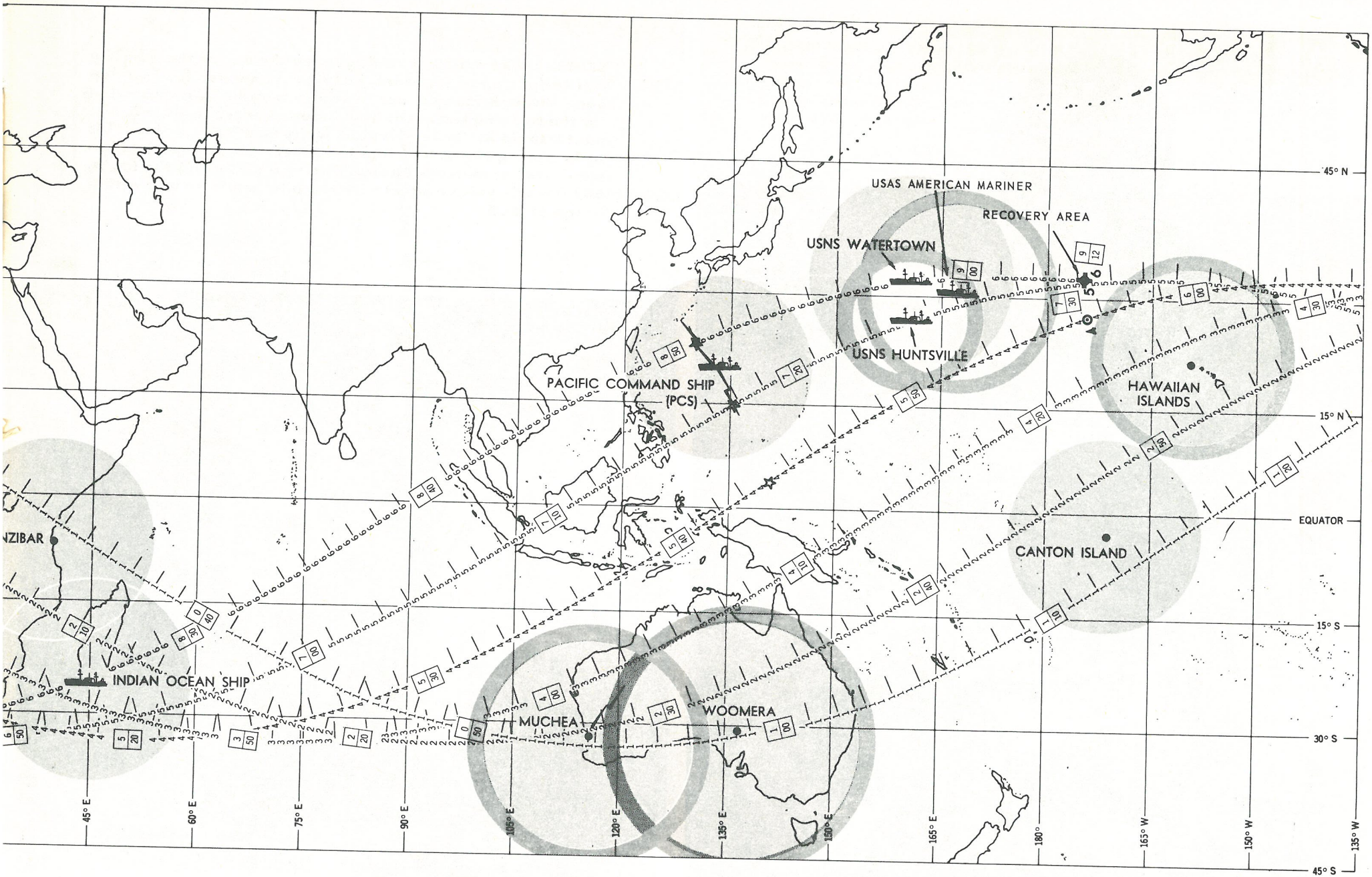
MA-8 ORBIT TRACK

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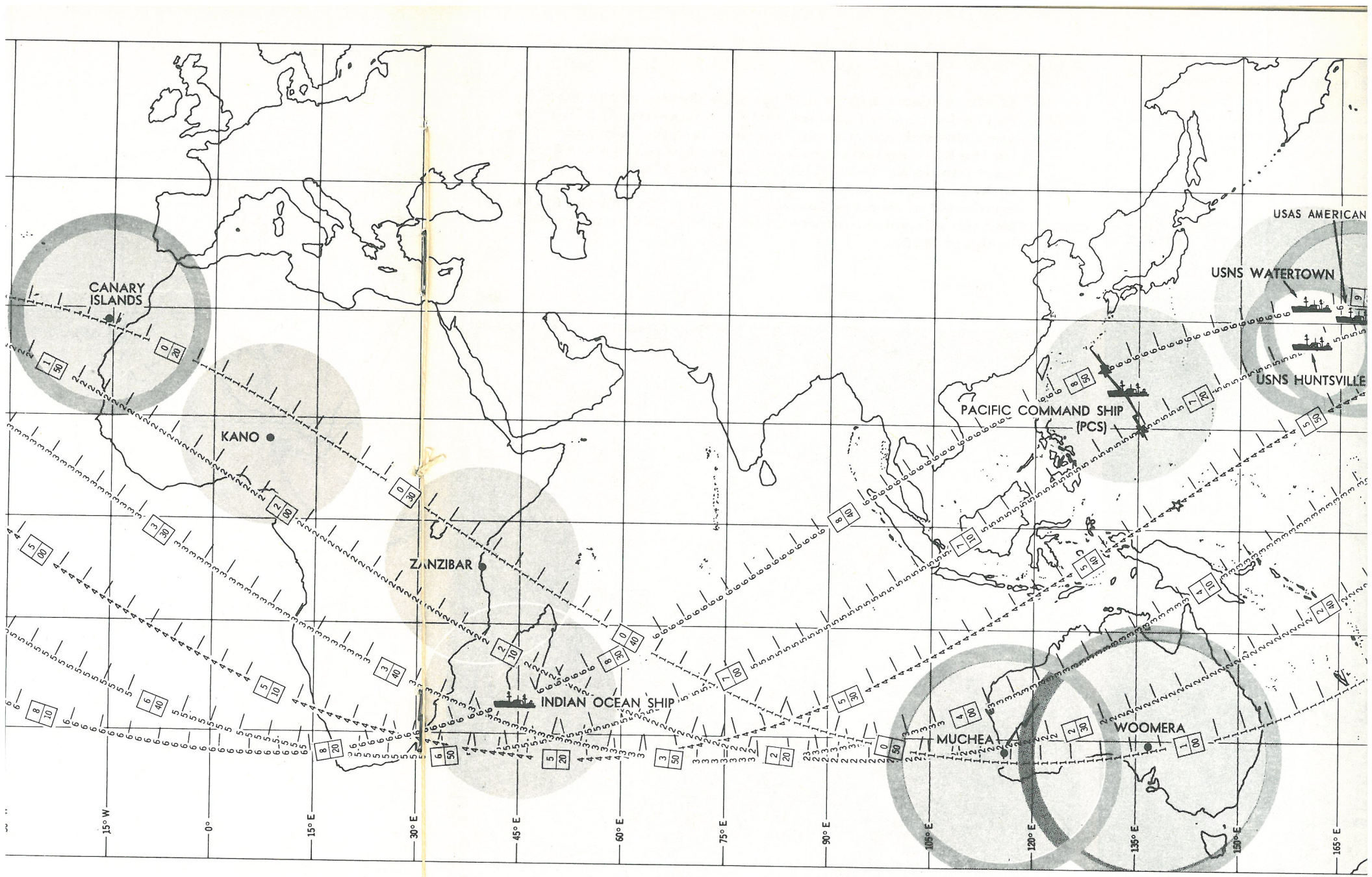
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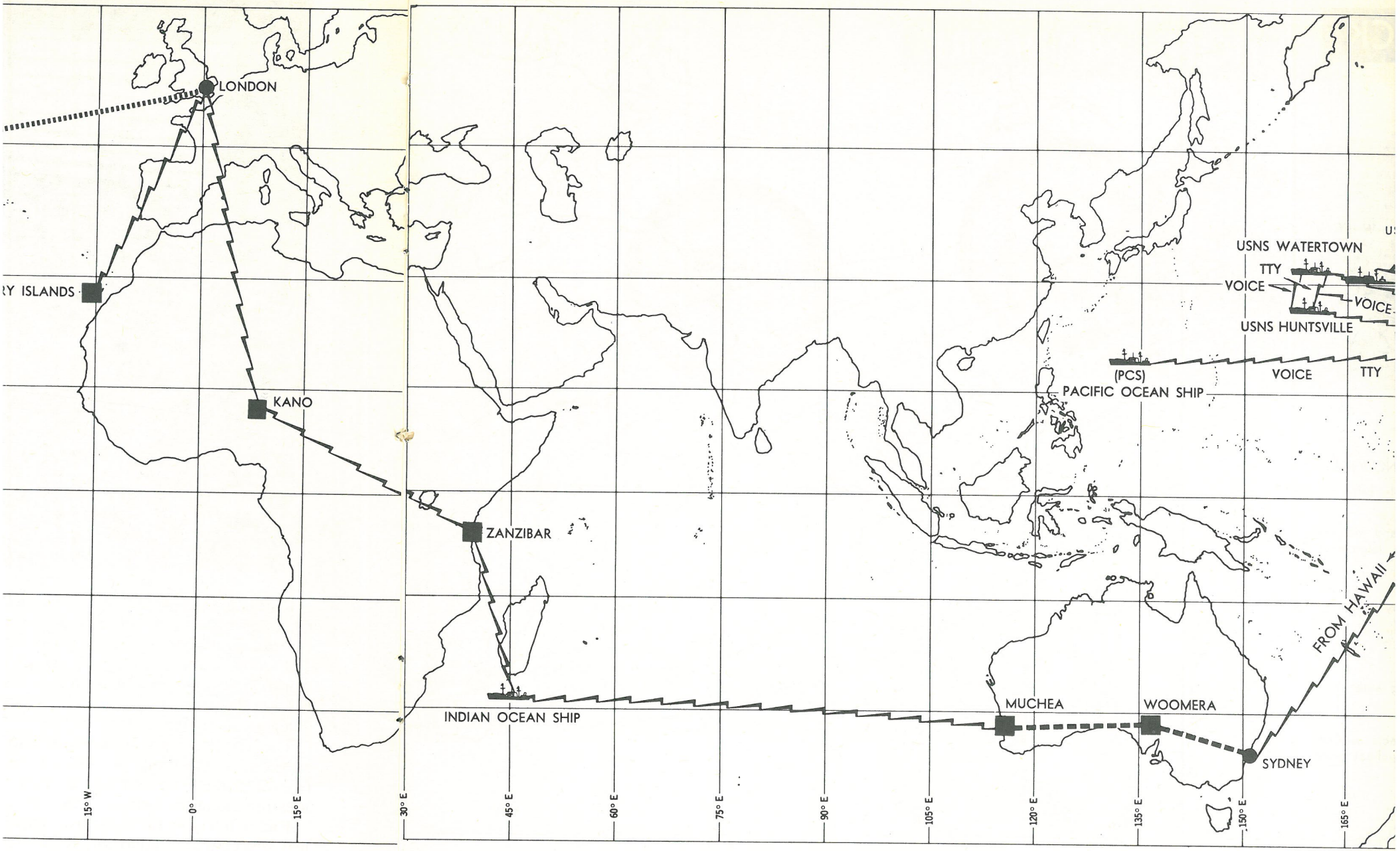
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